

THE Malayan Agricultural Journal

JANUARY 1930.

EDITORIAL.

With the present issue, the Malayan Agricultural Journal enters upon a new phase in its existence. The form of the Journal has been changed; in future the policy of the Journal will be to serve as a medium for the presentation not only of the results obtained by the Malayan Department of Agriculture but also by means of reviews and abstracts to call attention to work accomplished in other countries and to comment thereon in editorials and general articles. Arrangements have also been made for the inclusion therein from time to time of articles by members of other Departments e.g. the Department of Co-operation and the Rubber Research Institute, the work of which is cognate to that of the Department of Agriculture.

Original articles will so far as possible be couched in non-technical terms. The publication of strictly technical work being in future undertaken in the form of Special Bulletins.

It is believed that by following these lines a definite want will be supplied, and that the Journal in its new form will enter upon an increased sphere of utility.

The publication in this number of the Malayan Agricultural Journal of Messrs Bunting and Milsum's paper on Agriculture at Cameron's Highlands and Mr. Dennett's note on Soils at Cameron's Highlands should serve a useful purpose in that it affords the first published general review of the agricultural possibilities of that region. At present public attention is focussed on this region to a very marked extent, and it seems likely that as soon as adequate access facilities thereto have been provided, development on a considerable scale will be undertaken.

In these circumstances, the policy which has provided for the performance of a certain amount of agricultural experimental work before the Highland region became fully accessible must be admitted to be wise and far-sighted.

It is now clearly established that the Highland regions offer conditions which are suitable for the cultivation of Tea, Coffee, Cinchona and other upland tropical crops, and it is to be anticipated that extensive developments are probably only a question of time.

In this connection attention may well be called to the necessity for timely action to avert the losses which accompanied the opening up of hill lands in so many other parts of the tropics owing to insufficient protection against soil erosion once the protective cover of Forest is removed. Only attention in this respect may save the country from great waste of potential fertility. In this connection a leaflet on this matter is in course of preparation by the Department of Agriculture at the request of the Resident of Pahang.

A special Meeting of the Advisory Committee of the Department of Agriculture was held on Thursday December 12th for the purpose of discussing progress in relation to the development of the Tea Industry, at which various members of the planting public interested in this subject were also invited to be present.

The members visited the Experimental Tea Plantation at Serdang before the Meeting and inspected the experimental work in progress.

At the Meeting the subjects discussed comprised a review of the experimental work both at Serdang and Cameron's Highlands during the past year, the areas under cultivation and plans for assisting the further development of the Industry.

It was agreed that satisfactory progress had been made, the results obtained showing conclusively that both upland and lowland Tea could be grown very well under Malayan conditions. The actual area under cultivation in Tea in Malaya now totals some 1,500 acres, an increase of about 800 acres since the end of 1928. Programmes of work were discussed and it was decided to recommend that systematic experimental work should be commenced in the Highlands region as early as possible.

Provision has already been made for the erection during 1930 of an Experimental Tea Factory at the Experimental Station, Serdang, and this should facilitate research work and also the training of students at the new Agricultural School in methods of manufacturing Tea.

There should be a considerable opening for the consumption of locally produced Tea in Malaya itself, while in spite of the present congested condition of the tea market, there seems no obvious reason, in view of the proved suitability of Malaya for Tea cultivation, and of the large undeveloped areas adapted to this form of agriculture, why Malaya should not in due course take its place as one of the important Tea producing regions of the world.

Ever-increasing attention is being devoted to the science of Plant-Breeding, largely because of the very successful results obtained on the world's more important cereal crops. But the results obtained by the application of plant-breeding methods to annual crops such as cereals come to hand much more readily than when similar methods are adopted with a view to improvement of the semi-permanent and permanent crops of the Middle East, and for this

Research Work on Coconut Palms.

reason comparatively little selection work has been undertaken on these crops. For example, although there are some six million acres of coconuts in the tropics, the question of improving the crop by selection has hardly been touched, though the range of variation in cropping power of individual palms is so large, that the desirability of research work on these lines has been obvious for many years.

An effort is now being made to remedy this state of affairs and more attention is being devoted to Coconut research, not only on selection work but on other lines. In Ceylon, a Coconut Research Institute is being pushed forward. In Malaya, the article published in this issue indicates the position as regards selection work up-to-date, and the length of time involved (in this case 7—9 years) in necessary preliminary recording before the actual selection work can be undertaken, indicates the arduous nature of the task. Further developments in Coconut Research work are contemplated in Malaya. An Assistant Chemist has been specially appointed for Copra Research work; this work is now in hand and will be carried on to endeavour to discover the reason for the alleged inferiority of Straits Copra, and if possible to improve the standard of Copra from Malaya so that it will compare favourably with copra from other coconut producing countries. A Committee has been formed for the purpose of considering a comprehensive scheme of Coconut Research in Malaya and an account of the work of this Committee will be published in the next issue of this journal.

The article in this issue by Mr. J. Gordon-Carrie, on the statistics of rubber production, will be read with a good deal of interest, containing as it does, *inter alia*, information concerning the yield of rubber

Rubber Statistics.

from small holdings in Malaya based on actual ascertained returns over the whole area of the Federated Malay States. There is no question that the yields so established are considerably in excess of what many people expected would be the case. No doubt at the present time there are a number of factors operating which have tended to bring the production of the small holder to a level which is probably appreciably higher than that which may be anticipated under fully normal conditions, on the other hand, it also illustrates how easy it may be seriously to underestimate vital factors in the absence of definite and reliable statistical information. The success which has attended the institution of the service of statistics for rubber inspires the hope that the project for making similar provision for other agricultural industries may be productive of equally valuable results in other directions.

An important feature of a Department of Agriculture is the organisation provided for linking up the administrative head of the Department with the agricultural community of the whole country, for it is upon the efficiency of this organisation that the usefulness of the Department to the agriculturist largely depends.

The Field Division of the Department of Agriculture.

On the one hand, this organisation should provide the means for affecting improvement in agricultural practice and methods through instruction, both by precept and practical demonstration, and through the dissemination of information on agricultural matters provided by the research workers of its own and allied Institutions. On the other hand, it should be capable of providing the administrative head of the Department with information relating to all agricultural matters throughout the country, including the problems which need investigation by the Research Staff of the Department.

In the Department of Agriculture, S.S. & F.M.S., the Field Division is the organisation provided to perform these duties. This Division has become evolved from the former Inspection Division. The duties of the Division as at present constituted were set out in an editorial in the issue of this Journal for December, 1924; since this, experience showed that some further modification was necessary in order to enable the Division to perform with full efficiency the task allotted it. The matter received full consideration at the Field Officers' Conference reviewed elsewhere in this issue, and the conclusions established thereat should materially assist in arriving at a decision as to desirable developments in policy in order to attain the object in view.

Attention may be directed to the review of the annual reports of the Ceylon Department of Agriculture which appears in another column. These reports are of special interest to Malaya in view of the many points of resemblance which the two countries possess. Particular interest attaches to the reports of the Divisional Agricultural Officers which represent the mechanism provided for conveying the application of the research work done to the cultivator.

Extensional Work in Ceylon.

In Ceylon, extensional work of this nature has special reference to the small cultivators and finds its parallel in the system of agricultural consultants which exists in the Dutch East Indies, the duties of these officers being by means of propaganda, demonstrations and competitions to endeavour to raise the level of cultivation and hence of production on small holdings.

In Ceylon and Java these activities are separated from official measures for the control of pests and diseases, the view being held that they cannot be suitably combined.

The success which has attended efforts on these lines demonstrates that therein lies the secret of increasing the productivity of small holdings and thereby the prosperity of the country as a whole, and the lesson to be learned therefrom should not be overlooked.

AGRICULTURE AT CAMERON'S HIGHLANDS.

B. BUNTING,
Agriculturist,

and

J. N. MILSUM,
Assistant Agriculturist.

Introductory.

During the past 6 years, considerable interest has been shown regarding the agricultural possibilities of Cameron's Highlands, Pahang. This interest has recently become intensified owing to the progress made with the road from Tapah to the Highlands and the efforts of the Department of Agriculture with the experimental cultivation of tea and other crops at Tanah Rata.

The Department of Agriculture commenced work at the Experimental Plantation at Tanah Rata in January, 1926, since when considerable progress has been made. Before describing the results so far obtained it is considered advisable to outline the general climatic conditions and flora of the Highlands. Reference also is made to the behaviour of the various hill crops and other plants under cultivation together with observations regarding their possibilities on the Highlands.

It must be appreciated that the development of Cameron's Highlands is as yet in its infancy. Sufficient progress has been made, however, to show that many of the economic and ornamental plants that make the hill country in the Eastern tropics of such inestimable value may be grown with success under parallel conditions in the Malay Peninsula.

Climate.

The writers are indebted to Mr. C. D. Stewart, Superintendent, Meteorological Branch, Survey Department, for the following summary, taken over a period of four years, of the climate of Cameron's Highlands, together with an interpretation of the observations recorded:

**Summary of Meteorological Readings, Tanah Rata,
Cameron's Highlands, Pahang.**

Period 1925—1928.

Air Temperature in Degrees Fahrenheit.								Rainfall		Bright Sunshine.
	Mean Max.	Mean Min.	Mean of 1 & 2	Warmest Day.	Colest Night.	Colest Day.	Warmest Night.	Average Month's Fall.	Most in a Day.	Average daily total.
	(1) °F	(2) °F	(3) °F	(4) °F	(5) °F	(6) °F	(7) °F	(8) in.	(9) in.	(10) hours.
January	71	55	63	76	45	64	61	9.43	2.9	3.75
February	71	56	63	79	42	64	61	5.79	2.4	4.15
March	73	55	64	78	43	64	62	8.11	2.5	4.75
April	73	57	65	79	50	68	68	13.41	2.3	4.09
May	74	57	66	78	51	68	62	8.68	2.6	4.77
June	73	55	64	78	49	64	62	6.37	3.4	5.00
July	73	55	64	77	45	68	61	4.66	1.9	5.32
August	72	56	64	77	43	66	61	4.85	3.0	4.82
September	72	56	64	76	50	66	62	12.46	3.7	3.94
October	71	57	64	76	51	58	60	14.26	3.3	2.86
November	71	57	64	76	47	63	62	15.19	4.2	3.20
December	70	57	63	75	46	63	61	12.98	6.3	3.10
12 Months	72.0	56.0	64.0	79	42	58	68	116.19	6.3	4.15

The table gives the climatological characteristics of Tanah Rata, Cameron's Highlands, in so far as these can be gathered from observations extending over four years. A four year period is not sufficiently long to enable final exhaustive conclusions to be drawn, but nevertheless, the main features of this summary will give a fairly reliable indication of what may ordinarily be expected of the climate of Cameron's Highlands.

The seasonal changes of temperature are small, but are more distinct than any found in the lower lying parts of the Peninsula. The average values of the daily maximum temperature show this most clearly, the lowest occurring from October to February. The average night minimum, on the other hand, is much the same throughout the year; so that while the change in the position

of the sun shows its effect in the case of the maximum day temperature, it appears that night conditions do not change appreciably.

It is necessary, however, to give some attention to the summary of the individual readings, contained in Columns 4 to 7, inclusive. The averages already mentioned tend to smooth out to some extent differences which should not be lost sight of in a consideration of climate. The mean of 47° and 51° , for example, is 49° , the same as the mean of 41° and 57° , but the climatic conditions represented by the mean value of 49° would obviously not be the same in the two cases. This instance is both more simple and more exaggerated than anything to be found in the table, but the principle remains, namely, that in considering average values some attention must be paid to the range of the readings from which an average is obtained. In the July readings for instance, the warmest day and the coolest day, in four years, differed only by 9° , while in October, the warmest and coolest days during the four years had a difference of 18° . It is not possible to say as yet whether there is any regular change in this respect throughout the year, neither is any such generalisation possible regarding the nights. The difference between the warmest and coolest nights in October is only 9° while in February and March it is 19° . It is interesting to note that the coolest night in every month but two has been 50° or below, while 42° and 43° have been recorded on occasion. The warmest night in each month, on the other hand, is over 60° for all months, reaching, in one case only, the high figure of 68° . This temperature must be regarded as exceptional, as the warmest nights seem to keep very even throughout. The coldest night for different months shows wider variations.

Rainfall shows a very well marked seasonal variation with maximum values centring approximately at the times of the change of monsoons. The greatest rainfall in a day is nowhere very striking, the highest being 6.3 inches, which occurred in the exceptionally wet season at the end of December, 1926.

Sunshine is seasonal in the same way as temperature, the longest days' sunshine being experienced in the middle of the year. The rainy periods have their effect, as shown by the somewhat diminished values for April and October as compared with the neighbouring months, but aside from this the succession is hardly broken.

The above remarks are not to be regarded as a critical examination of the climate of Cameron's Highlands. As has already been remarked, some years of further observations are required. The intention of these notes is to indicate how the tables may best be studied and to summarise the principal features of the data already obtained.

Flora of the Highlands.

Mr. H. N. Ridley, late Director of Gardens, Straits Settlements, made an extensive collection of plants in the locality in the year 1908, but did not proceed further than Gunong Berembun which is at the commencement of the Highlands.

Ridley's paper published in the "Journal of the F.M.S. Museums," Vol. IV, No. 1, December, 1909, describing the journey from Tapah to Lubok Tamang valley adjoining the Sungei Bertam, is of particular interest. A description of the plants collected, containing many new to science, is of considerable value as a guide to the vegetation of the region. Fairly numerous collections have been made since Ridley's visit and several new plants obtained.

When the boundary line of Pahang is reached, on the road to the Highlands, a marked change in the flora occurs, plants showing relationship with Himalayan types of vegetation being seen. These increase in numbers towards the higher ridges. At Tanah Rata and other low-lying areas of land adjoining the Sungei Bertam, the forest is comparatively thin. During certain months of the year, the ground is studded with flowering herbs, the commonest being the Himalayan Violet (*Viola serpens*), the golden balsam (*Impatiens oncidoides*), begonias, and terrestrial orchids. As the mountain ridges are climbed the trees become dwarfed, while on the summits the flora is partially xerophytic. The soil as well as the stems and branches of all the shrubs and trees are thickly covered with mosses, ferns and liverworts. To the untrained eye the vegetation of the Highlands is not particularly interesting, being ever-green with a general absence of conspicuous flowering plants. A notable exception is seen on several of the hills in the Highlands area during the early months of the year when *Rhododendron Wrayi* is in flower, with its large masses of pink and white blooms.

The introduction of a selection of the numerous beautiful trees and flowering plants, that are such a feature of the mountain districts of Java and Ceylon has boundless possibilities. A few of such plants are already established; brief reference is made to these towards the end of this article.

Situation of the Plantation.

The Experimental Plantation at Tanah Rata is situated at the extreme South-east corner of the Highlands at an elevation of about 4,750 feet. The lower area adjoining the Sungei Bertam is about 4,640 feet, while the highest area so far cleared for planting is approximately 4,800 feet above sea-level.

The greater part of the plantation is sheltered by the surrounding mountain ridges, which include Gunong Berembun (6,036 feet) on the eastern side and Bukit Mentigi (5,120 feet), previously known as Rhododendron Hill, on the western side. Gunong Jasar (5,565 feet) and Gunong Ruil (5,680 feet) are more distant in a north-westerly direction, while Bukit Kumunting (5,074 feet) and Gunong Batu Brinchang (6,665 feet) are towards the north. Gunong Batu Brinchang which marks the limit of the Highlands proper is about $3\frac{1}{2}$ miles from Tanah Rata.

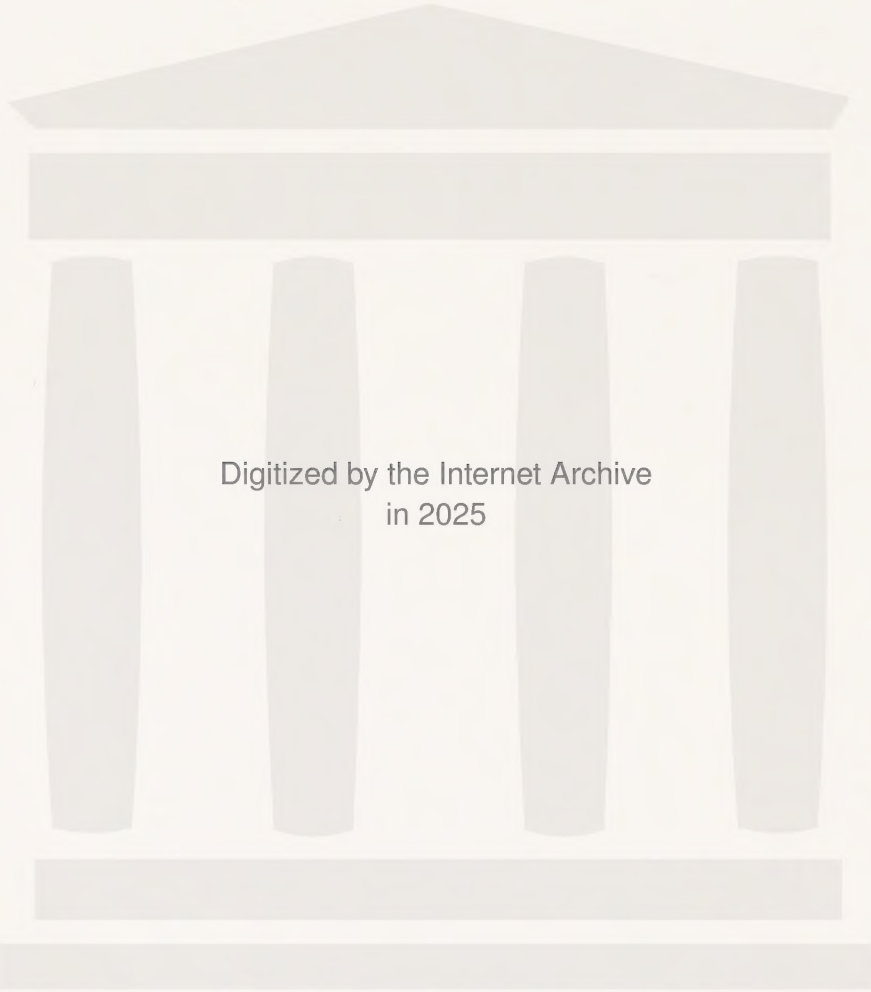
Although the mountain ranges surrounding the plantation afford protection for the various crops under cultivation they have the effect of reducing the amount of sunshine to a considerable extent.



View of Experimental Plantation, Tanah Rata from Bukit Mentigi showing,
reading left to right.

Spur No. 1, Old Tea, Coffee arabica and Cinchona,

Spur No. 2 Cinchona, Spur No. 3 Young tea.



Digitized by the Internet Archive
in 2025

The total area of the plantation at present is 220 acres including Blocks D₁, half of D₂, E₁, E₂, F₁, and F₂, as shown on the Grid Map prepared by the Survey Department. Each block contains an area of 40 acres.

The opened area is approximately 80 acres comprising mainly Block D₁ and E₁.

Tanah Rata is situated at latitude 4°28' "North and longitude 101° 23' " East.

Development of the Plantation.

The Assistant Economic Botanist (Mr. W. N. Sands) visited the Highlands in September, 1922, with a party headed by the late Mr. H. C. Robinson, then Director of Museums, Federated Malay States. A report by Mr. Sands on the agricultural possibilities of the Highlands was published as Federal Council Paper No. 6 of 1923. A paper by the same writer appeared in the Malayan Agricultural Journal, Vol. X, page 269, under the heading of "The Agricultural Possibilities of Cameron's Highlands, Pahang." In this paper, reference is made regarding the exploitation of Mr. William Cameron, the eponymous discoverer of the Highlands, who travelled through this part of Pahang in 1885. A report by Mr. V. R. Greenstreet (Assistant Agricultural Chemist) on certain soil samples collected at Lubak Tamang, a valley adjoining the Sungei Bertam (3,600 feet elevation) south of the Highlands, and at Cameron's Highlands was published in the same number of the Malayan Agricultural Journal.

In January, 1925, a visit was made to the Highlands by a party of Agricultural Officers including one of the writers, who took up with him a small quantity of seed of three "jats" of Assam and Manipuri tea, obtained from India for planting at the Experimental Plantation, Serdang, Selangor. Two hundred seeds of each "jat" were sown in prepared nursery beds.

A number of *Cinchona* seedlings (*Cinchona Ledgeriana* and *C. succirubra*) were transplanted from nursery beds in to larger beds adjoining the area planted with the tea seeds. The *Cinchona* seed had been taken up to the Highlands on a previous occasion by the Economic Botanist. A report on the introduction of *Cinchona* appeared in the Annual Report of the Economic Botanist for 1924, published in the Malayan Agricultural Journal, Vol. XIII, page 213.

In March, 1925, the Chief Secretary to Government, Sir George Maxwell, K.B.E., C.M.G., inspected the Highlands with a party of Government Officers. It was then decided that the agricultural activities of the Department should be developed on a larger scale. In December, 1925, Mr. J. P. Wilkins was appointed Superintendent and the direction of the plantation was taken over by the Agricultural Division in January, 1926.

Labour.

When the plantation was first opened Dyaks were employed as general labourers and Sakais for felling jungle. The former were satisfactory but

proved expensive. The Dyaks were replaced by Tamils in February, 1926, the latter soon settling down to the conditions obtaining on the Highlands. The Superintendent was able to establish a connection with South India and all labour now employed arrives direct from the Coast. At the present time adult male Tamils are paid at the rate of 65 cents per day. The health of the labourers is particularly good and no difficulty is experienced in maintaining an adequate labour force.

MAJOR CROPS.

A summary of the cultivations on a large scale at high elevations in neighbouring countries, for example Ceylon, Java and Sumatra, shows that the number of possible major crops is restricted, the most important being tea, Arabian coffee, and cinchona. All these crops have been established at the Experimental Plantation and although they have but recently reached the cropping stage, their growth and behaviour to-date are promising.

Tea.

It is not proposed in this article to refer in any great detail to the experiments with tea at Tanah Rata, as this has already been published (vide *Malayan Agricultural Journal*, Vol. XVII No. 1, page 7).

The original area of Assam and Manipuri tea (Dangri, Dhonjan and Rajghur "jats") planted in January, 1926, with one year old seedlings continues to make good growth. This area comprises about 430 bushes, with a planting distance of 4 feet by 4 feet, which gives 2,722 plants per acre.

Plucking operations commenced on the 24th July, 1927, i.e., about 2½ years, from sowing the seed. The bushes were cropped regularly at intervals of 9 to 10 days. The following are the calculated yields per acre of dry tea from this area taking the area of these plots as 1/6th of an acre:—

First plucking year ending 23rd July, 1928 = 470 lbs.

Second plucking year ending 23rd July, 1929 = 525 lbs.

Though the soil of the particular piece of land is rather poor, being very peaty with a sub-strata of quartz, the growth and "flushing" of the bushes have been vigorous.

Owing to the present inaccessibility of the Plantation as far as transport of heavy articles is concerned, it is as yet impossible to instal any machinery, and for this reason it is at present a matter of difficulty to gauge the quality of the tea produced owing to the primitive process employed.

The following reports have been recently received through the courtesy of Messrs Guthrie & Co., Ltd., Kuala Lumpur, who forwarded two samples of hand-made tea from the Experimental Plantation, Cameron's Highlands, to their London Office for report and valuation:

REPORT BY MESSRS CHARLES HOPE & SON, LONDON, DATED 15TH OCTOBER, 1929

“Leaf.”—This Tea has the appearance of a leafy well graded Broken Orange Pekoe with a fair show of good coloured tip and does not contain any very coarse leaf.

Cup Quality.—The liquor has the character which is usually associated with very young leaf. It is light in colour of cup and has indications of being somewhat over-fired.

Infusion.—This is bright and is the best characteristic of the Tea and rather leads us to suppose that the Tea is well manufactured with the exception of being over-fired, but that the green leaf is lacking in essential oil.

The tea would sell on this Market in competition with low grown Northern Indian Tea or Java, mostly for its appearance, its cup quality being unattractive.

To-day's value, the market being on a very low basis, is about 11d.

<i>Description.</i>	<i>Character.</i>	<i>Value.</i>
Hand made Broken Orange Pekoe.		per lb.
<i>Leaf.</i> —Black, even, well made, fair tip.		1/3d
<i>Infused Leaf.</i> —Fairly bright.		
<i>Liquor.</i> —Light, brisk, little high fired.”		

A commencement was made during the latter part of 1927 to extend the area under tea with seedlings raised on the plantation. A total area of 30 acres is now planted comprising various Assam and Manipuri “Jats”. The following varieties have been planted:—

Dangri.—A pure Manipuri jat, derived from the original Manipuri stock. It has a dark leaf, is very hardy and bushes quickly.

Dhonjan.—A pure Assam variety derived from indigenous Assam stock. It has a large dark green leaf, flushes freely and is comparatively hardy.

Betjan.—A pure Assam stock, having a large leaf of medium colour but not so large as some of the light-leaved varieties. It is a heavy yielder and noted for its large “fat tips.”

Rajghur.—A cross between a pure Assam and a pure Manipuri plant. It is a high yielder and very hardy.

Seed of these “jats” were obtained from the Dangri and Dhonjan Tea Seed Co. Ltd., Dibrugarh, Upper Assam.

Charali Manipuri.—A pure Manipuri plant having a dark leaf.

Charali Assam.—A pure Assam variety having broad leaves of medium colour.

Amulguri.—A pure indigenous dark leaf Assam plant.

Dutea Manipuri.—A pure Manipuri variety.

Muttapong Manipuri.—A dark leaf Manipuri plant.

These seeds were obtained from Messrs. E. S. Stewart & Co., Calcutta.

These varieties have been planted on what is known as Spur C in Block E1. This area is divided into one acre plots. The land is hilly and steep in

places, but characteristic in this respect of the majority of the land in the Highlands area. The young bushes are making good growth and show promise of forming a fine field of tea.

The area is planted with trees as shade and wind breaks including the following: *Acacia decurrens*, *Grevillea robusta*, *Albizzia moluccana* and *Dalbergia assamica*. The following leguminous trees have been introduced for use as green manures: *Erythrina lithosperma* (thornless dadap), *Gliricidia maculata*, and "Boga medeloa" *Tephrosia candida*. Cover plants have been established on certain of the plots, the most promising or these at present being *Dolichos Hosei* and *Indigofera endecaphylla*, the former is likely, however, to be troublesome owing to its climbing habit. The whole area is divided into one acre plots which are subject to various forms of cultivation, i.e., terracing and silt pits.

Seed of Manipuri tea Rajghur, sufficient to plant one acre, has recently been obtained from tea seed bearers at Ginting Simpah (2,000 feet elevation) in Pahang.

Also 3,000 tea seeds have been obtained from Escot Estate, Tanjong Malim, from seed bearers raised from seed originally obtained from an up-country estate in Ceylon. This tea, when established, will be of particular interest as representing second generation tea in Malaya.

In November, 1929, $\frac{1}{2}$ maund of seed of each of the undermentioned "jats" was forwarded by the General Export Company, Calcutta, for trial on the Highlands. These varieties are described as follows:—

Taikong.—A dark leaf pure Assam jat of a hardy type producing a vigorous plant.

Markong.—A dark leaf pure Manipuri jat, hardy and vigorous.

It will be seen, therefore, that a comprehensive collection of tea "jats" is established at the Experimental Plantation. The majority of the plants are as yet quite young being about 2 years old from seed, but the behaviour and growth of the bushes is encouraging.

An area of $4\frac{1}{2}$ acres comprising Assam and Manipuri "jats" raised from seed planted early in 1927 has reached the cropping stage and plucking was recently commenced.

Rates on land for Tea Cultivation.

The rates proposed by Government for grants of land for the cultivation of tea are as follows:—

Premium dependent on the situation of the land with regard to roads—no definite figure has been laid down.

Rent one dollar per acre per annum for the first six years and thereafter four dollars per acre per annum.

Importation of Tea Seeds.

The importation of tea seeds and plants into the Federated Malay States and Straits Settlements is governed by F.M.S. Gazette Notification 2829 of



View of Nursery, Experimental Plantation, Tanah Rata, Citrus in foreground,
tea seedlings, Gunong Jasar behind,

26.4.29 and S.S. Gazette Notification 767 of 26.4.29, respectively. These notifications result in "Living plants or parts of plants including seeds of tea" being included in Schedule A of the Plant Importation Rules under the Pests Enactment of the Federated Malay States and Pest Ordinance of the Straits Settlements.

Briefly, this means that those who wish to import tea seeds into Malaya have to observe the following regulations.—

- (a) Written permission of the Director of Agriculture or, in his absence of the Chief Field Officer, must be obtained before the seeds are despatched from the country of origin.
- (b) Seeds imported must enter by one of the Entry Ports, namely Port Swettenham in the Federated Malay States; Singapore and Penang in the Straits Settlements.
- (c) Each consignment of seeds must be accompanied by a Certificate of Freedom from diseases or pests issued by a duly authorised official in the form given in Schedule B of the Plant Importation Rules.
- (d) The seeds will be inspected upon arrival at an entry port by an Inspector who has power to deliver to the importer or subject the consignment to whatever treatment he may deem necessary for the destruction of any pest.

Coffee is also included in Schedule A of the Plant Importation Rules.

Cinchona.

When the Experimental Plantation was taken over by the Agricultural Division in January 1926, a number of seedlings of both *Cinchona Ledgeriana* and *C. succirubra* had been established by the Economic Botanist from seed obtained from Java in June, 1924. The majority of these plants, however, were washed away by the severe flooding of Sungei Bertam which occurred during December, 1926. A few plants survived and were planted out on terraced land. A number of trees are growing fairly well, but on the whole they show uneven growth.

A further quantity of seed, consisting of 25 grammes of *C. Ledgeriana* and 25 grammes of *C. succirubra* was received from Java in October, 1926. On the 18th November, half of the seed of each variety were sown in carefully prepared seed beds. Germination commenced on the 9th December, 1926, and ended in March, 1927. A large number of seeds germinated and were transplanted into nursery beds at the end of March, 1927.

These seedlings were again transplanted in September, 1927, being spaced 6 inches apart in nursery beds, which were lightly shaded with bracken. Owing to the dampness on the Highlands, considerable care is needed in keeping the young plants in a vigorous growing condition. *Cinchona* is a very difficult

plant to establish and requires careful handling in both the seed and nursery beds in order to develop into robust seedlings which will eventually withstand transplanting in the field.

The balance of $12\frac{1}{2}$ grammes of seed of each variety was sown in May, 1927. Germination commenced within a month from sowing and a further supply of seedlings were ready for transplanting in nursery beds at the beginning of October, 1927.

In October and November, 1929, a large number of seedlings were planted in the field. These seedlings were planted 4 feet apart on terraces, the vertical interval between the terraces being about 7 feet.

An experiment was also commenced with the object to test the effect of shade on the growth of cinchona and two acres of jungle were cleared of all undergrowth and small trees for this purpose.

At the present time there are approximately 5 acres of cinchona planted in the field and 2 acres planted in thinned out jungle making a total area of about 7 acres or roughly $3\frac{1}{2}$ acres of each variety.

Although there are isolated patches in both *Ledgeriana* and *succirubra* plots in which the trees show good growth, poor patches are found throughout the planted area, which gives it an uneven appearance. It should be stated, however, that general unevenness of growth is characteristic of *Cinchona* cultivation, consequently due allowance must be made for this particular factor in judging the standard of growth on the Highlands. The poor growth is especially noticeable where the young trees are on peaty soil. On the higher parts of the area where the peat layer diminishes and a deep clay-loam soil commences the trees have made considerably better growth.

A sample of bark of *C. Ledgeriana* submitted for analysis to the Government Quinologist, Mungpo, India, elicited the following report dated the 10th May, 1929:—

“The samples of Bark from the Federated Malay States were not large enough to test separately. In fact not large enough for a very accurate analysis even when all mixed together.

But the result I have obtained is 6.6 per cent. Quinine Sulphate and no appreciable amount of Cinchonidine, a very nice bark.”

The Superintendent of *Cinchona* Cultivation in Bengal, in forwarding the report made the following comments: “It will be seen that the samples could not be analysed separately through insufficiency of material, but the average content is very good indeed”. Larger samples have recently been forwarded to India for examination and report. Particulars of the trees from which the samples were taken are as follows:—

1. Seed germinated in December, 1926.
2. Planted in the Field in November, 1927.
3. Samples collected March, 1929.
4. Height of bushes about 6 feet.



Cinchona Succirubra Growing at Tanah Rata.



Cinchona Ledgeriana Growing at Tanah Rata.

Further seed was sown in April, 1929, in specially constructed seed beds as employed in the Cinchona Plantations in Northern India. At the present time there are a large number of seedlings of both species in nursery beds that will be ready to plant in the field during the year.

The following extract from a report entitled "Cinchona in the Empire" by Mr. J. M. Cowan, lately officiating Director, Botanical Survey of India and Superintendent of Cinchona Cultivation, Bengal, is of interest. The report is issued by the Empire Forestry Association, London, in the form of a reprint from the Empire Forestry Journal Vol. 8 No. 1, 1929.

"The ecological factors necessary for the successful growth of *Cinchona Ledgeriana*, so as to yield a satisfactory return of bark and alkaloid, may be summarised as follows. In India it has been found that suitable conditions are only present where there is evergreen forest on granitic or volcanic rock formations. The soil must be rich, porous, well-drained and with moderate to steep slopes. The least water-logging is fatal to the plants.

As to climate, *Cinchona Ledgeriana* will stand neither great heat nor frost; the ideal temperature may be taken as about 75° F., with a mean minimum of 60° F. and a mean maximum of about 85° F. A hot sun with no shade is unfavourable. The limits of rainfall are roughly from 75 to 180 ins. per annum. Even 200 ins. may not be excessive on a well-drained soil, but a much lower rainfall on a stiff clay would prove disastrous. The upper limit in altitude is about 5,000 feet and the lower limit about 1,500 or 1,000 feet. *Cinchona* grown at low elevations usually has, however, a poor percentage of alkaloids. Although the above particulars indicate the type of land that may be suitable for cinchona, it must be remembered that, even in a locality where all conditions appear to be favourable, it is advisable to plant experimentally before attempting operations on a large scale."

The writers consider that the preliminary results obtained with the cultivation of *Cinchona* on the Highlands are distinctly encouraging and that undoubtedly suitable areas exist where its extended planting might be carried out with success.

Arabian Coffee.

A small parcel of 1½ lbs. of "Kents" Arabian Coffee seed was received from the Department of Agriculture, Mysore, in March, 1927. The parcel contained 3,750 seeds or approximately 2,500 seeds to the pound. A small area was planted during September, 1929 with the seedlings raised. A further consignment of quarter bushel of Kents' Arabica Coffee seed was received from Mysore and 26,900 seeds were sown in nursery beds on the 20th February, 1928. Germination commenced in April and finished in May, producing 25,500 seedlings, which represents approximately 94 per cent. germination within a period of about 3 months. The seedlings were planted out in the field during the early part of May, 1928.

A total area of 6 acres is planted with this crop. The bushes appear very healthy and are growing vigorously. The older bushes, planted during September, 1927, commenced flowering in March, 1929 and now show the first crop of berries.

Cardamoms.

A small supply of seeds was received from the Department of Agriculture, Ceylon, during March, 1928. Seed of both the Mysore and Malabar varieties were obtained. Germination commenced two months later. The plants made excellent growth in the nursery beds. The area under this crop has recently been extended to two acres; a piece of ravine land cleared of undergrowth only being planted with suckers obtained from the original plants in the nursery beds. Judging from the behaviour of these plants and the fact that Zingiberaceous plants abound in the Highlands, there appears little doubt that the cultivation of cardamoms will be attended with success. The elevation at which the cardamoms have been planted, namely 4,750 feet, is considered rather high for this crop.

MINOR CROPS.

Numerous economic plants are under trial on a small scale both in the nurseries and in the field.

A number of fodder grasses introduced from the Experimental Plantation, Serdang, have proved successful on the Highlands and the following details may be of interest:—

GUINEA GRASS, *Panicum maximum*.—This grass thrives remarkably well at all elevations leading up to the Highlands and growth is equally good at 4,750 feet elevation as on the plains. Small areas are planted at Jor, at Renglet, Lubok Tamang and Tanah Rata for feeding pack mules. This valuable fodder grass should prove useful for feeding all kinds of stock on the Highlands.

CARPET GRASS, *Axonopus compressus*.—This grass thrives at Tanah Rata and appears to grow more vigorously than on the plains. It should prove useful as a grazing fodder. When kept scythed it may be employed as a turf in gardens.

AUSTRALIAN BLUE COUCH, *Digitaria didactyla*.—This species shows remarkably vigorous growth and thrives considerably better on the Highlands than it does on the plains. It is proving useful for grazing and turfing of slopes.

Other grasses which have been successfully established on the plantation include Bermuda grass (*Cynodon dactylon*), Citronella grass (*Cymbopogon citratus*), Lemon grass (*C. nardus*) and Vetiver grass (*Vetiveria zizanioides*). A fine leaved grass originally raised from seed obtained from England has become established. It is of tufted habit and appears to be suitable as a grazing fodder. This grass so far has not been observed to flower, hence the difficulty in naming the species.

Tuba Root.

A small plot of "tuba puteh" (*Derris elliptica*) has made very healthy growth and proves quite amenable to the climate of the Highlands. Plants 20 months old yield an average of one pound of root (wet weight). In view of the value of this plant for insecticidal purposes, the knowledge that it will thrive at such a high elevation is of some importance.

Fruits.

The climate and elevation of the Highlands is not suitable for the successful cultivation of the majority of temperate fruits.

The following fruits have been introduced and have so far shown good results:—

Strawberry.—An area of about half an acre has been established with a variety originally introduced from the Philippine Islands. This variety appears well suited to local conditions and produces fair crops of fruit of good flavour, though small in size as compared with produce as grown in Europe. Other varieties, raised from seed obtained from England, include Improved Red Alpine, Large Red Alpine and Royal Sovereign. These varieties so far have fruited poorly, the tendency of the plants being to produce numerous suckers.

Rhubarb.—Considerable success is being obtained with rhubarb raised from seed. Plants under a year old are producing at a single picking over 4 lbs. of sizeable sticks of good flavour. It is evident that this garden crop will thrive well on the Highlands.

Tree Tomato.—This salad fruit has been successfully established. The egg-shaped fruit, which is produced in great abundance, may be kept for several weeks after plucking without affecting its quality for edible purposes. The average weight of a ripe fruit is about 2 ozs. and a single tree will produce hundreds of fruits in the course of a year. It is in season almost throughout the year.

Passion Fruit.—This climber (*Passiflora edulis*) produces its oval purple fruit in great abundance.

The Mountain Papaya, *Carica candamarcensis*, commonly grown in hill gardens in Ceylon, has been introduced and is making good growth. The green fruit may be used for making into jam and preserves.

Other fruits which have been planted include lemon, orange, grape fruit, pomelo, Cape gooseberry, guava and persimmon. The majority of the fruits are growing well but so far the trees are of insufficient size to produce fruit.

The wild raspberry (*Rubus rosaeifolius*) occurs in quantity in opened land.

It is probable that the cultivated forms of raspberries will succeed, though an attempt to establish them from seed failed owing to the seeds not germinating.

Vegetables.

The following vegetables have been grown from time to time with excellent result:—lettuce, radish, green pea, beans, beetroot, onion, carrots, potatoes, Jerusalem artichoke, cabbage, Kohl-rabi and tomatoes. The cultivation of vegetables has, however, sometimes been attended with disappointing results owing probably to the acid nature of the newly opened land and the heavy rains during the wet seasons. Insect pests, notably the Cut Worm (*Prodenia litura*), have proved a considerable difficulty in vegetable cultivation, especially during the early stages of growth. It should be noted that the present small area of land opened, surrounded by extensive areas of jungle, probably results in the vegetable crops being more subject to the depredations of insects.

It has been found that continuous and heavy rains at critical stages of the vegetables' growth proves ruinous.

It is evident that good hill vegetables may be raised where the land is systematically cultivated and manured. It is anticipated that with the development of the Highlands, supplies of vegetables in quantity will become available for sale in the large towns in the Peninsula.

Ornamental Plants.

A large number of the flowers, shrubs and ornamental trees that succeed at Fraser's Hill, Pahang, and Maxwell's Hill, Perak, have been introduced.

The following plants are mentioned as of particular interest:—

Flowering cherries raised from seed obtained from the Southern Shan States. These trees have made remarkably rapid growth but so far have not flowered.

Bulbous plants from South Africa; several species, notably *Agapanthus umbellatus*, *Crinum Moorei*, *Watsonias*, *Moraeas* and *Montbretias*, are growing and flowering well. The Arum lily was introduced from Newara Eliya, Ceylon, early in 1929.

Roses are a conspicuous success; bushes raised from cuttings obtained locally and imported plants have both done well.

Ornamental trees from Australia are thriving particularly well. These include the following species:—

Eucalyptus globulus (Blue Gum), *E. citriodora*, *Acacia Bayleyana*, *A. decurrens*.

Cryptomeria japonica, *C. knightiana*, *Grevillea robusta*, *Cupressus macrocarpa* and *Casuarina* spp. are also thriving.

Conifers show promise of being a great success on the Highlands and there is considerable scope in the introduction of such trees suitable for this elevation. The Asahan Pine (*Pinus Merkusii*), a pleasing feature of the hills in Sumatra and Java, has been established. This evergreen pine grows well at

Ginting Simpah (2,000 feet elevation) in Pahang, where comparatively young trees have reached a height of 20 feet and more and now produce seeds.

Mention has already been made of the fact that indigenous Rhododendrons are a feature on the higher hills of the Highlands. The soil being acid and in many places peaty it is most probable that many species of this beautiful genus may be introduced with success. *Rhododendron arboreum*, a fine species from the Ceylon hills, and numerous others from Sikkim, should be established as soon as opportunity occurs.

THE SOILS AT CAMERON'S HIGHLANDS.

By

J. H. DENNETT.

Assistant Chemist,

Division of Soils & Plant Physiology.

In the article which follows it is necessary to use a certain number of semi-technical terms in regard to soil (though they are terms evolved by the layman long before the study of the soil became a science) and it therefore does not seem out of place to say a few words about soil in general.

Everyone is aware that soil is formed by the mechanical and chemical decomposition of rocks due to the action of weather. As it weathers the quartz which the rock contains is set free and gives rise to a large extent to the familiar large grained constituent of the soil—sand, while part of the quartz on the other hand remains combined with the alumina of the rock and gives rise to that other familiar soil constituent—clay, which is of microscopic fineness.

The "texture" or "lightness" or "heaviness" of a soil will depend to a large extent on the relative proportions of the sand or clay particles. The sand particles may not of necessity consist only of quartz but also of small undecomposed fragments of rock within certain limits of size.

The study of the soil soon shewed that it was possible, by an arbitrary division of the particles of which it is composed, to classify the terms which had been in use by the farmer for centuries (i.e. loam, clay, sand etc.) to correspond to soils within definite limits of mechanical composition.

The particles of which the soil is composed are divided according to size into stones, gravel, coarse sand, fine sand, silt and clay. It is obvious that any soil may consist of any mixture of these and three main groups have been made (1) sandy soils, (2) loamy soils (3) clay soils. These groups can be further divided as follows:—

1.—Sandy soils.

- | | | |
|-----------------------------------|---|------------------------|
| (a) Sands | } | i. Coarse sand. |
| Clay and silt practically absent. | | ii. Sand. |
| | | iii. Fine sand. |
| (b) Loamy sands | } | iv. Loamy coarse sand. |
| 15—20% Clay and silt together. | | v. Loamy sand. |
| | | vi. Loamy fine sand. |

2.—Loamy soils.

- | | | |
|------------------------|---|-------------------------|
| (c) Sandy loams | } | vii. Coarse sandy loam. |
| 20—50% Silt and clay | | viii. Sandy loam. |
| together. | | ix. Fine sandy loam. |
| (d) Loams | } | x. Loam. |
| Over 50% Silt and clay | | xi. Silt loam. |
| together. | | |

3.—Clay soils.

- | | | |
|-----------------------|---|-----------------------|
| (e) Clay loams | } | xii. Sandy clay loam. |
| 20—30% Clay. | | xiii. Clay loam. |
| | | xiv. Silty clay loam. |
| (f) Clays | } | xv. Sandy clay. |
| Over 30% clay. | | xvi. Clay. |
| | | xvii. Silty clay. |

The above table is of course to some extent arbitrary but it provides a means of giving a soil of known composition a definite name. It may further be reckoned that for general purposes subgroups (a), (b) and (c) are lighter soils and subgroups (d), (e) and (f) are heavier soils.

In addition to the mechanical composition of the soil a knowledge of its chemical constituents is essential.

One important factor is humus which is formed by the decay of leaves etc. By it we mean the organic material which the soil contains in a form which is likely to be readily assimilated by the plant, and, roughly speaking, if there is a good quantity of dead plant material overlying or mixed up with the upper layer of the soil, one might expect a fair quantity of humus.

From the humus and dead plant remains generally the plant derives much of its nitrogen.

Certain mineral constituents of the soil are as essential to plant life as they are to human life, namely potash, phosphorus and lime and to a lesser extent magnesium, so that a knowledge of the quantities of these, particularly the first three, which the soil contains is of importance.

The Highlands.

A vast part of the soils of Cameron's Highlands are of granite origin as will be obvious to the most casual observer during a tour of the area. As granite contains a high percentage of quartz it would be expected that soils formed therefrom would contain a good percentage of sand.

The soils of the Highlands are comparatively young and it would appear possible that in some cases the soils are of a sedimentary nature, that it so say, they have been removed from their original sites by the action of rain.

The average depth of useful soils throughout the Highlands seems to be about 3 feet when either parent rock or a very stony soil is reached. Many places do occur where the depth is considerably deeper, but on the other hand, rock may occur within a foot of the surface and it is considered that three feet represents a good average.

Soils have been found to range from coarse sands to friable clays, light soils however predominate.

From casual observation along roads and bridle paths it seems almost as though the soil varied every few yards, but the variation is less real than apparent and is rather due to what might be described as different states of tilth and/or the presence of greater or lesser quantities of humus.

Changes of course occur, but not so rapidly as that, and the soils on the whole roughly follow the contours.

The following description is given of individual areas.

Tanah Rata 4700 feet.

This area is of special interest as it is contiguous to the town sites and it is here that the Experimental Plantation of the Department of Agriculture is situated.

The soil of slopes to the south west where young tea seems to be thriving well varies from a sandy clay loam to a coarse sandy loam and is of a good yellowish red colour with a fair amount of humus. The soils all become more open in texture with increasing depth, thus ensuring the good drainage that tea needs. They are all on the acid side of neutrality thus fulfilling another requirement of tea.

Contiguous to these slopes, on the hill on which the Agricultural Superintendent's Bungalow is situated, were found patches of pure quartz gravel and sand covered by thin layers of clay and peat. A small area of tea on this land seemed to be doing very well and is bearing excellently, but it cannot be considered that such land is of any great general agriculture value. Coffee and Cinchona certainly do not thrive on it and whether the tea will do so well when the roots get down to the barren quartz is open to doubt, though it may still be able to draw sufficient nourishment from the acid peat-clay layer. Similar areas have been found further north particularly at Brinchang, on the slopes of the Gunong, but in any case these outcrops are very small, appear only intermittantly and have not been encountered further south or east of Tanah Rata. Visually, quartz sand outcrops appear similar to the white clay which sometimes occurs with the weathering of granite. They can, however, be immediately differentiated by feel.

The majority of the soil at Tanah Rata, however, varies as stated above, from sandy clay loam to a coarse sandy loam and seems admirably suited to tea. Along the bridle path from Tanah Rata to Kuala Habu the soil is of much the same texture and is very definitely of an open nature.

Lubok Tamang.

This area has been previously reported on by Mr. Sands, Assistant Economic Botanist, in the *Malayan Agricultural Journal*, Volume X, 1922. It consists of a semivalley area chiefly on the east side of the Bertam stretching roughly from the junction of the Bertam and the Habu to the junction of the Bertam and the Renglet. The land for the most part is gently sloping to flat going to steeper hills to the west and east.

The soils of this area have been thoroughly prospected, having first been reported on as probably suitable for tea as far back as 1914. They shew a wide range of variation and appear to extend in merging belts in a north and south direction and roughly following the configuration of the land. The variations found are clay, clay loam, sandy clay, sandy clay loam, sandy loam and coarse sandy loam so that most of the soils of the above table are represented. The clay soils are quite friable as will be appreciated from the tables which follow (soils R319 & R330) as they contain quite a fair proportion of sand. Following what is to be expected as a rule in the Highlands, the soils of the area become lighter with increasing depth, making for good drainage. Down the valley of the Renglet the soils vary in much the same way as at Lubok Tamang and the area although not very extensive, generally seems to be promising.

Habu Valley and Road Trace to Tanah Rata.

The soils around the road trace shew much the same variations as Lubok Tamang. At the 35½ mile the soil is a friable clay while along the Habu Valley itself there is a very promising sandy loam with a good quantity of humus. This type of soil stretches to beyond the 37th mile. At the 38th mile a further area of reddish brown friable clay occurs very similar in texture to that at the 35½ mile. By the 39th mile the soil changes to a sandy clay not so rich in humus and mineral plant food as those previously encountered, while by the 40th mile the soil becomes a sandy clay loam rather poor chemically. Generally speaking, the land on either side of the road trace is steep, and cultivable areas consist of recurrent spurs capable of being terraced. The Habu Valley area though small, appears promising.

From the 40th mile back to Tanah Rata the land is more or less flat and passes through the future village area. There is much peat and white clay in evidence.

North west of Tanah Rata the soil again appears to be decidedly variable with a number of small quartz outcrops.

Outer Highlands.

An expedition was made from the Outer Eastern Highlands from Kuala Habu towards Sungei Boh plantation following the valley of the Ulam.

For about the first mile from the Kuala the soil consists of a sandy clay very like the granite soils encountered in Selangor. From this point on, the soil shewed the same variations as the other areas. At about two miles from the Habu a very interesting area of almost flat park-like land was met with possessing a clay top soil going to a sandy clay loam below. About a mile and a half further on, a similar flat area was encountered having a clay loam soil rich in humus. Beyond this until the Ginting was reached, the soil was a fair sandy loam going to coarse sandy loam below, very similar to that occurring on the tea slopes of Tanah Rata. Soil samples taken on Sungei Boh itself were found to be of the same nature.

General.

Although soils of all textures were encountered during the survey, yet the predominating type is a light one, chiefly sandy loams. The soils are all on the acid side, which is what tea requires. It may be considered as practically impossible that an alkaline lime soil will be found in Malaya at anything approaching the height of Cameron's Highlands.

On the whole, the soils are decidedly richer in mineral plant foods and nitrogen than are the corresponding lowland soils and they seem very suitable for tea and garden produce, though for the latter, despite their comparative richness, manuring will certainly be necessary.

Java and Assam.

It is of interest to compare the soil of Cameron's Highlands with those of Java and Assam tea soils.

In Java tea is grown on soils varying from coarse sand (only about 6 per cent. of clay and silt) through various intermediate soils to a very heavy clay containing up to 80 per cent. of clay and 10 per cent. of silt.

In Assam the heaviest soils, which are found in the Sibsagar district, contain about 50 per cent. of clay and are of a decidedly sticky nature, while the lightest soils are very similar to the lightest tea soils of Java.

It should be pointed out that the Java soils are largely of volcanic origin and that the sand fractions in consequence are likely to be richer in plant food than the Malayan Hill soils of granite origin.

The best Java soils contain about 1 per cent. of nitrogen with an average of about 0.35 per cent. while the corresponding figures for Assam are 0.2 per cent. and 0.1 per cent. The organic matter, which is about the same for both countries, is about 10 per cent.

The potash content of Java soils is high while the phosphorus content is lower than the Assam figures which vary from about 0.05 to 0.15 per cent; in both countries the total lime varies from about 0.1 to 1.0 per cent

Both the Java and Assam soils are slightly acid having an average pH value of 5.5 (pH 7.0 means a neutral soil, a lower figure than this indicates a soil on the acid side, a higher figure a soil on the alkaline side of neutrality).

Although tea is grown in Java on soils as nearly neutral as pH 6.8 soils having a pH of 6 or over are considered bad for tea in Assam.

It is of great interest to compare the figures mentioned above with those obtained with the soils of Cameron's Highlands.

Approximate Limits of Mechanical Composition.

Soil	Gravel	Coarse sand	Fine sand	Silt	Clay
Java Tea (most sandy)	... 47	37	4	2	6
Java Tea (most clayey)	... —	1	4	14	82
Assam Tea (most sandy)	... 10	40	38	4	8
Assam Tea (most clayey)	... —	15	25	10	50
Cameron's Highlands (most sandy)	... 50	37	5	3	5
Cameron's Highlands (most clayey)	... 22	23	5	4	46

Approximate Averages of Mineral food stuffs etc.

Soil	pH	Potash%	Phosphorus%	Lime%	Nitrogen%	Organic Matter%
Java Tea	... 5.5	circa 1.0	0.01—0.07	0.1—0.5	0.35	10.0
Assam Tea	... 5.5	0.1—0.5	0.05—0.15	0.1—0.4	0.10	10.0
Cameron's Highlands	... 5.0	0.1—0.3	0.03—0.1	0.02—0.08	0.2	12.0

It would seem from the above figures that Cameron's Highlands soils compare quite favourably with the tea soils of Java and Assam. The lime content of the two latter is somewhat more than that found locally, but as pointed out previously, tea is not a lime loving shrub. The difference in the average pH value is negligible.

In both India and Java, the practice of artificial manuring is resorted to, and experience has shewn that what is chiefly required is nitrogenous and phosphatic manures, additional potash having very little effect.

Without in any way suggesting it as a manurial programme the following figures are of interest as indicating replacement requirements in Java.

Manures are applied at so much per bush. The following quantities have been recommended by the Theeproefstation of Java: 10 grams ($\frac{1}{3}$ oz.) sulphate of ammonia per bush with or without the same amount of superphosphate, or about 30 grams (1 oz.) urea or 75 to 100 (3—4 oz.) of fish guano. This works out for sulphate of ammonia at about 70 lbs. per acre per annum.

In conclusion it may be pointed out, in connection with the statement above, that manuring would very definitely have to be resorted to for market gardening, that the quantities of manures required for this purpose would be greatly in excess of that required for a permanent crop like tea. The ideal for market gardening without doubt is cattle manure, but it is unlikely that there would ever be sufficient of such manure in the highlands for large scale vegetable production, and it will therefore generally be necessary to apply a full chemical treatment to get the best results.

SELECTED TYPICAL SOIL ANALYSIS.

Ref. No. Locality.	Clay.	Silt.	Fine sand.	Coarse sand.	Gravel.	Stones.	pH.	Potash as K_2O .	Phosphorus as P_2O_5 .	Lime as CaO .	Nitrogen.	Loss on Ignition.	Type.
A. Lubok Tamang.													
R314T	32	11	5	22	20			.450	.050	.032			Sandy clay do do
Sa	32	12	13	24	13								
Sb	32	12	14	26	13			.426	.034	.025			
R315T	18	17	17	19	21	8					.218		Sandy loam Sandy clay loam Sandy clay loam
Sa	23	16	13	21	15	4					.082		
Sb	21	17	13	19	20	7					.062		
R316T	23	25	15	20	16			.570	.037	.032			Clay loam Sandy loam Sandy loam
Sa	18	18	20	21	22			.440	.041	.025			
Sb	12	17	19	21	29			.440	.030	.025			
R319T	31	12	14	18	14	1							Clay Clay Clay
Sa	33	8	10	18	11						.179		
Sb	35	12	11	20	11	3					.117		
R330T	44	2	5	20	19						.067		Clay Clay Clay
Sa	49	2	5	17	26	3					.291		
Sb	44	10	6	22	17	2					.134		
											.079		Clay
B. Road Trace.													
R609T	59	5	8	11	1		44	0.040	.1065	.063	.3320	28	Clay
Sa	52	11	9	14	10		4.7	0.470	.0716	.050	.0196	15	Clay
Sb	49	7	11	17	16	22	4.8	0.067	.0561	.049	.2380	10	Clay

SELECTED TYPICAL SOIL ANALYSIS.—(Cont.).

Ref. No.	Locality.	Clay.	Silt.	Fine sand.	Coarse sand.	Gravel.	Stones.	pH.	Potash as K_2O	Phosphorus as P_2O_5	Lime as CaO .	Nitrogen.	Loss on Ignition.	Type.
B. Road Trace.														
R610T		20	26	16	18	8		4.1	0.094	.0694	.073	.0784	27	Sandy loam
Sa		12	30	32	17	7		4.4	0.070	.0654	.056	.1120	13	Sandy loam
Sb		4	12	34	15	13	2.5	5.4	0.084	.0286	.055	.2012	22	Loamy sand
R613T		32	19	11	12	26	4	3.9	0.084	.0260	.028	.2940	13	Sandy clay
Sa		26	28	18	11	17	5.6	4.2	0.097	.0402	.025	.2800	14	Sandy clay loam
Sb		28	24	17	11	18	9.4	4.4	0.150	.0048	.028	.2744	10	Sandy clay loam
C. Tanah Rata.														
R620T		25	14	8	28	25	3.3	3.9	0.108	.0328	.051	.2488	18	Sandy clay loam
S		32	20	9	20	15.5		4.5	0.154	.0363	.071	.1624	15.5	Clay
R622T		13	9	6	28	41	3.5	4.8	0.060	.0381	.078	.2240	18	Coarse sandy loam
Sa		5	8	4	19	60	4.1	5.2	0.033	.0716	.053	.1932	2	Loamy coarse sand
Sb								5.0						
R337T		13	9	7	33	26	4							Coarse sandy loam
Sa		6	13	10	48	25	2							Loamy coarse sand
Sb		3	3	8	46	39	7							Coarse sand
D. Outer Highlands														
R615T		31	14	10	20	10		4.0		.1065	.028		40	Sandy loam
Sa		11	14	28	25	9		6.1		.0631	.066	.0140	27	Sandy loam
Sb		5	12	17	42	10		5.8	0.130		.056		25	Coarse sandy loam

SELECTED TYPICAL SOIL ANALYSIS.—(Cont.).

Ref. No. Locality.	Clay.	Silt.	Fine sand.	Coarse sand.	Gravel.	Stones.	pH.	Potash as K ₂ O.	Phosphorus as P ₂ O ₅ .	Lime as CaO.	Nitrogen.	Loss on Ignition.	Type.
R617T S	26	27	19	14	11		4.2	0.361	.0716	.043	.3584	14	Clay loam
	29	31	25	14	4		4.6	0.725	.0458	.068	.1344	10	Clay loam
D. Outer Highlands R619T Sa Sb	30	16	6	19	27		4.3	0.233	.0572	.050	.3304	12	Sandy clay
	29	16	9	16	30	2.3	4.6	0.195	.0521	.028	.2464	9	Sandy clay
	26	10	6	20	35	4.1	4.9	0.247	.0272	.069		6	Sandy clay loam
E. Brinchang. R332T Sa Sb	5	5	5	34	44	5							Coarse sand
	6	9	12	42	29	2							Coarse sand
	6	16	25	35	16	1							Sand
R333T Sa Sb	21	15	11	32	13	1		.400	.021	.034			Sandy clay loam
	32	15	11	23	9			.520	.056	.031			Sandy clay
	32	16	13	18	6			.530	.040	.034			Sandy clay

IMPROVEMENT OF THE COCONUT CROP BY SELECTION.

Being a lecture delivered at Bagan Datoh Club on 2nd May, 1929.

BY

H. W. JACK,
Economic Botanist.

Introductory.

Though coconut cultivation covers an area of some six million acres and has been a stable industry in the tropics for many years, the question of improving coconut crops has hardly been touched.

The significance of this statement is all the more surprising when due consideration is given to the vastness of the industry, to the great length of the economic life of the coconut palm when grown under fair average conditions and to the fact that individual palms show such a wide range of variation in fruiting ability. Moreover, in temperate regions, the consumption of coconut oil for confectionery and in the soap and other manufacturing industries has increased enormously within the past two decades. For instance, in 1910 coconut oil was hardly known in the United States of America. Furthermore, the future development of the coconut industry would appear to be assured since the steady increase in oriental populations situated within or near coconut growing regions has produced an increasing demand for fresh nuts for culinary purposes, thus counterbalancing to some extent the areas which are being planted annually by large exporters. The striking increase in the utilization of the products of the coconut palm leads to the anticipation that not only will their present uses expand, but that new uses may be found for them in the future, so that the potentialities of the industry are difficult to gauge. Hence it is all the more astonishing that so little attention should have been paid to investigating methods for improving this very important crop.

Improvement.

The improvement of the coconut crop may be considered from several aspects. For *areas which have already been planted*, the main line of improvement would suggest the amelioration of the environment by whatever means may be found to be feasible. Thus, soil conditions may be capable of very great improvement by better cultivation, by growing cover crops or crops suitable for green manuring; by the application of artificial manures, by improved drainage, by irrigation, by reducing acidity or by other means, but in adopting any of these methods or combinations of them, scientific advice should first be sought and

the cost of adopting the selected method must be balanced against the possible crop returns. It may even prove remunerative to destroy unprofitable palms and replace them by seedlings derived from known heavy producing palms which have been growing under very similar environmental conditions. Also the possibilities of increasing crops by root pruning or by wound effects are deserving of investigation. Then again, there is the question of eliminating or controlling pests and diseases which are known to affect the crops adversely and regarding which there are yet many unsolved problems.

The application of any of the above methods of improvement is still comparatively novel, and reliable data, on which their relative merits may be gauged, are difficult, if not impossible to obtain, so that there is unlimited scope for research along these lines.

As regards future plantings, apart from the various methods which may be found economically successful in ameliorating the environment of the palms in new areas, the effect of careful selection of seed nuts from tested palms should prove attractive, since, as already stated, individual palms growing under apparently similar conditions show a wide range of producing ability.

As the title indicates, this lecture will be confined to the consideration of this method of improvement.

The term "*selection*" as regards seed coconuts is misapplied to a very large extent at present, because the methods of selecting them are far from scientific and are rarely based on a thorough examination of the individual tree. The commonest method of selection is that of purchasing seed nuts from a well established estate which is known to produce a fair quantity of copra per acre. This method is tolerably sound in the absence of reliable tree data as long as the trees from which the nuts are derived are growing in similar soil, subjected to similar water conditions to those existing on the area where it is desired to establish a new plantation, but it merely ensures the production of trees of average utility; in other words it is not selection at all. An improvement on this method is that of examining the trees in the field and marking as parents those individual trees which show desirable characters or which closely approximate to an approved type, and using only the fruits from those palms as seed nuts for new plantings. This method, if thoroughly performed, should result in a more uniform plantation than the more casual method which is usually adopted, though complete uniformity cannot be obtained because trees which appear very much alike, differ not only constitutionally, but seedlings from the same parent tree may be found to vary to an extent as yet undetermined, on account of the cross pollination which takes place to a very large extent between "tall" palms as compared with "dwarfs".

Variation.

Variation is common to all crops, annual and perennial and in coconut cultivation, *variation* is well known to occur in many characters. Some of

these such as colour, size and shape of fruit, are readily apparent, while other characters can only be revealed by careful investigations covering an extended period. In the latter category can be included seasonal variation in cropping, variation in root formation, variation in female flower production, and in the production of mature fruits per palm, variation in size and shape of nut, in thickness of meat, in oil content of the meat, in the rate of germination of seed nuts from different palms of the same variety, in disease resistance and in other characters. Some of these variable characters are obviously affected by cultivation, but despite all cultivation, variation will persist.

The *chief variable characters* of economic importance are, however, (a) the amount of copra produced by individual palms and (b) the percentage of oil in the copra derived from individual palms.

Variation in Copra production per Palm.

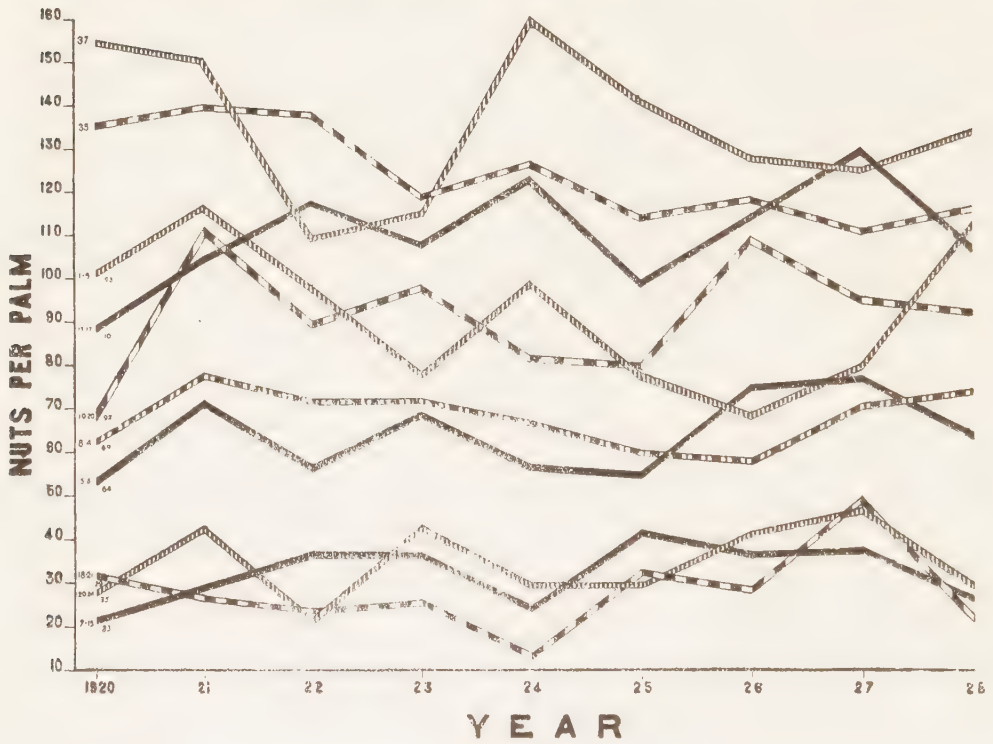
With regard to the variability in the amount of copra produced by individual palms, this is the most important factor affecting the planter, because the chief marketable product of the coconut is copra. Little is known concerning the methods of purchasing copra in Europe, and though sometimes one hears of copra being bought according to oil content, I think it may safely be said that copra is judged and priced mainly by the appearance of the commodity and without any reference to intrinsic values based on analyses (c.f. rubber). The Department of Agriculture is investigating the methods adopted in the copra market in Europe, but at the present time, all that is known is that in the local market, copra is valued solely by its general appearance; hence in order to meet market requirements, the main concern of the planter is to produce large quantities of copra of good appearance. In other words, quantity not intrinsic quality is the essential factor; therefore variation in the amount of copra produced by individual palms is of first importance in any effort to improve the coconut industry from the producer's aspect.

An investigation of this character (yield of copra per palm) involves a study of the fruit producing ability of different trees and indicates the advantage of maintaining a cropping register for individual palms. The maintenance of such a register over a large area would not prove a practical task but offers no particular difficulty in selected areas of 40 or even 50 acres.

Such a register would not be a sure index of the copra producing ability of a palm, since due consideration must be given to the size and shape of the nuts and to the thickness of the copra, still it should afford a reliable indication of the extent to which variation occurs and greatly assist in selecting good producing palms. Amongst the causes of variation in cropping in a mixed population, due weight must be given to the importance of cultural operations and in particular, to general environmental conditions which are likely to differ somewhat for every palm even where such conditions appear identical, but the hereditary characteristics of the palm must not be overlooked because, despite

DIAGRAM I.

VARIATION IN COCONUTS 9 YEARS



the variable factors of environment, each palm retains its own individuality as long as conditions favour a fair degree of development. In confirmation of this statement, it has been found, through the systematic records on which these notes are constructed, that in a mixed population of tall palms such as is found on any coconut estate, good producing palms on the average remain proportionately good yielders from year to year, while poor yielders continue to produce poorly.

An examination of Diagram No. 1 will illustrate the constancy of fruit yielding ability of average, good and high producing palms. This diagram shows that the annual fruit production of each palm is constant over a period of nine years, within the limits of seasonal variation. (15% of the mean, as shown in the Malayan Agricultural Journal, Vol. 16. page 379).

Thus the annual yields of fruits in each case fluctuate above and below the mean yield over the entire period. As was anticipated, the annual fluctuation about the mean is insignificant in the case of the average producing palms. It is more apparent with palms of medium utility while for high producing palms the annual variation is marked. Of course, the records on which the diagram is based do not cover a sufficiently long period to render the figures absolutely reliable, but their comparative uniformity over a period of 9 years would certainly indicate that the ability to fruit, apart from seasonal variation, is an hereditary character.

An extensive study of the variation in fruiting ability of individual palms was initiated in June 1920 on a local estate of good productive capacity as may be gauged from the fact that the field in question produced, over the past 8 years, an average of 11.35 pikuls of copra per acre.

The rainfall on the estate averages around 95 inches per annum and is well distributed throughout the year except that July is usually fairly dry.

A block which originally carried 480 palms growing in twenty consecutive rows, each row containing twenty-four palms, was chosen as being fairly representative of the conditions on the estate, and each palm was labelled with its row and palm number. Of these palms, 4 which had died and 5 which were young supplies are omitted so that the records deal with 471 palms.

In June 1920, the average age of the palms was just 10 years; originally the palms were planted 30 x 30 feet apart. The estate is well drained, having a water table some 4.5 feet below the surface of the soil. The block under experiment is surrounded on all sides by a drain four feet deep and six feet wide at the top and intersected by two subsidiary drains four-and-a-half feet wide by three feet deep which divide the block into four equal-sized areas. One subsidiary drain runs between rows 10 and 11 and the second cuts it at right angles between the 12th and 13th palms of each row.

The soil consists of a rather stiff alluvial clay loam somewhat on the heavy side for coconut cultivation, but to all appearances very uniform in texture throughout the block. Primarily, the estate was clean-weeded but midway through the experiment a cover crop of *Centrosema plumieri* was sown and slowly

established itself affording a fair cover crop. This cover was removed in the sixth year of the experiment when the area was cultivated to a depth of 8-10 inches.

On this block the ripe fruits were cut every 5-6 weeks by means of a curved knife attached to the end of a long bamboo as most of the fruit bunches were 30-40 feet from the ground. *Expert* pickers always performed this operation and piled the fruits from each palm at its base ready to be counted.

The results of each picking have been carefully preserved and summarised and compiled into a frequency Table (Table I) from which mathematical calculations can be made in order to show at a glance what conclusions may be drawn from the results.

The results can also be portrayed graphically in what is known as a frequency curve,* which represents diagrammatically and with mathematical accuracy the results of the observations derived from a large mass of figures, which in themselves would convey little tangible information.

The Frequency Curve visualises at a glance, the results of many measurements of any particular character—in this case number of nuts produced per palm per annum.

Table I and Diagram II (frequency curve from Table I) show the range of variation (5 to 115 nuts) the mean and the group frequencies of the average production of nuts per palm per annum over a continuous period of eight years on the block under observation e.g. in Diagram II, if horizontal and vertical lines are drawn from the highest peak of the curve to the side line (frequencies) and the bottom line (groups) respectively, it will be seen that 88 of the palms in the block each produce an average of 55 nuts per annum over a period of 8 years.

The figures in this table prove the land to be of good average productive capacity since the average number of fruits obtained per palm per annum is 59 which is usually regarded as a satisfactory figure, being some 13 nuts better than the average for large estates.

Moreover, the nuts are of good average size since the average annual yield of copra per acre over the area during the period was 11.35 pikuls (1510 lbs.) and the actual average number of nuts per acre per annum for the same period was 2,783 so that 245 nuts were sufficient to produce one pikul (133 lbs.) of copra, which is considered a fair average.

In comparing different variable characters or the same characters in different individuals, biologists use a term called the co-efficient of variability. This is merely a convenient method of comparing different nuts or individuals and is found by expressing the variation of any character as a percentage of the mean for that character. The variable character in this instance is number of nuts per palm per annum.

* A frequency curve is a means of expressing results in which the figures obtained are classified in numerical groups and the number of results which fall in each group are plotted seriatim.

TABLE I.

Groups.	F.	% of total No. of Palms.	F × G.	d.	d. ²	Fd ²
5 ¹	1 ²	.2	5	54 ³	2916	2916
15	11	2	165	44	1936	21296
25	34	7	850	34	1156	39304
35	44	9	1540	24	576	25344
45	65	14	2925	14	196	12740
55	88	19	4840	4	16	1408
65	83	18	5395	6	36	2988
75	71	15	5325	16	256	18176
85	35	7	2975	26	676	23660
95	32	7	3040	36	1296	41472
105	5	1	525	46	2116	10580
115	2	.4	230	56	3136	6272
N = 471 $\sum F \times G = 27815$					$\sum Fd^2 = 186156$	

Mean = $\sum F \times G \div N = 27815 \div 471 = 59.09$, say 59. nuts per palms per annum
= 2783 nuts per ac. per annum.

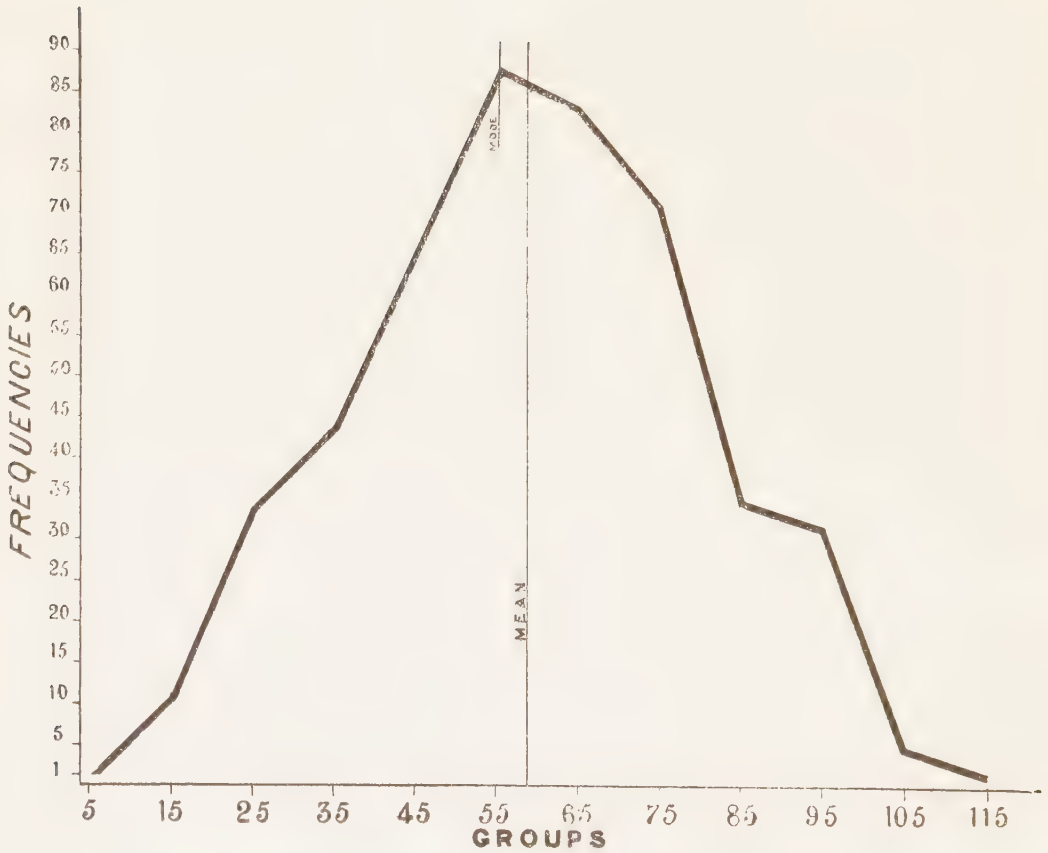
1. Nuts per palm per annum to the nearest group figure.
2. No. of palms per group.
3. Deviation group figure from the average or mean yield of nuts per palm per annum.

$$\text{Standard Deviation} = \sqrt{\frac{\sum F.d^2}{N}} = \sqrt{\frac{186156}{471}} = \sqrt{395.24} = 19.88$$

$$\text{Coefficient of variability} = \frac{\text{S.D.} \times 100}{N} = \frac{19.88 \times 100}{59} = 33.6949$$

say 34%.

DIAGRAM II.



Frequency Curve showing range of variation in Average Yield of Fruit per Palm per annum in a Group of 471 Palms over a continuous period of Eight Years.

The co-efficient of variability shows that if any palm on the experimental area is chosen at random, its average fruit yielding capacity is likely to vary from the mean productive capacity of all the palms in that area by as much as 34% of the mean value.

For the sake of simplicity and in order to explain the term "co-efficient of variability" let it be assumed that the mean production per palm per annum is 60 nuts instead of 59, the actual mean. Then, the chances are even, that any palm chosen at random on the block in question will have an average annual productive capacity of $\pm 34\%$ of 60 nuts, that is, it will fall within a group containing all those palms having an annual production of from 40 nuts up to 80 nuts, or, in other words, any palm picked at random is unlikely to vary from the mean of *all* the palms of the entire population by more than 20 nuts per annum. Table I also shows that, if an average yield of 40 nuts per palm per annum is regarded as the lowest profitable production figure for estates, (some estates reckon on 30—35 nuts as sufficient to show a profit) then 93 palms or 19% of the palms on the block are not profitable under ordinary conditions, though it might, of course, be possible to improve them by special cultivation and manuring or by other means. This Table further shows that 74 palms or 15.7% of the total number have annually averaged 80 nuts per palm or more and have produced 6,770 nuts or 24.3% of the entire crop. Similarly 39 palms or 8.3% of the population (that is all those with an average annual yield of 90 nuts and upwards) have produced 3,795 nuts or 13.7% of the total crop.

Bearing in mind that the yielding ability of all the palms on the block appears to be constant and that the range of variation in production of individual palms is so wide, it would seem possible to improve vastly the total productive capacity of the area by eliminating all those palms which fruited unprofitably or even all those which yielded annually less than the average and by replacing them by the progeny of palms tested for high yield of copra. The planting of seedlings amongst already mature palms hardly gives the young plants a fair chance of attaining their best development, since the conditions of free growth are seriously hampered, particularly as regards sunlight and root competition, still the substitution of seedlings from high yielding parents is likely to prove economic in comparatively young plantations. On the area in question, work along these lines is in progress since all the unprofitable palms have been cut out and have already been replaced by seedlings from selected parent palms.

As already described, the experimental area is fairly typical of good average coastal coconut land in Malaya, so that it may confidently be assumed that a similar degree of variation would be found on other profitable coconut areas where alluvial coastal conditions prevail. This wide and constant range of variation, revealed by figures dealing with records over an eight-year period, strongly emphasises the economic possibilities of scientific selection of high yielding types. Such a selection involves not only the number of fruits which each

palm is capable of producing but due consideration must be given to the average size of the nuts produced by each palm and to their copra content, because it is quite conceivable that a palm which normally only produces 70 large fruits per annum may yield more copra than a palm of which the average annual fruit production is 90 or 100 or even more smaller nuts.

Not only is a wide range of variation apparent in the number of fruits produced per palm annually, but the size of the nuts varies greatly on different palms, thus affecting the amount of copra which the fruit of each palm is capable of producing.

TABLE II.

Palm No.	No. of nuts used in determination.	Average copra produced per nut in grams.	Average annual fruit production per palm over 8 years.	Average annual copra production per palm in lbs.
1 (a)	34	254	55	31
3	30	270	90	54
12	27	264	111	65
3 (a)	35	215	76	36
10	26	236	105	55
2 (a)	32	275	53	32
13	25	206	157	72
17	25	245	99	54
1	18	180	83	33
100	15	283	113	71
47	19	195	20	9
43	18	290	29	19
38	10	302	126	85

Within fairly narrow limits it has been found that the size of nut produced by any palm is fairly constant provided that fair average growing conditions are maintained and allowing for seasonal variation. Also the mean size of nut of different tall palms (as judged by the weight of meat) varies (up to as much as 70%) as can be seen from column 3 of Table II which covers several pickings with most of the palms. Though the size of nut from individual palms

is fairly constant, a seasonal variation of about 15% is frequently found between the size of nut at different pickings from the same palm.

Thus, as can be seen from col. 5 of Table II, the amount of copra produced per palm annually is variable according to the number of fruits produced per annum and to the size of the nuts, and since the average palm produces about 30 lbs of copra per annum, the value of a plantation in which all the palms average 50 or 60 lbs. of copra per annum or more is obvious.

Unfortunately, as yet we know little of the genetics or hereditary characters of the ordinary tall coconut palm except that many palms are hybrid in their constitution since cross pollination takes place to a very large extent, but experiments with the object of investigating the genetics of the coconut are well under way at the Klang Coconut Selection Experiment Station and should produce a fund of useful information in due course. As regards the dwarf coconut palm, the position is already much more satisfactory because by observation and by experiment we know that the three races of dwarf, the green, red and yellow, which are fairly common locally, are genetically comparatively pure, since the rate of production of flowers ensures a high percentage of self pollination. Thus, if the planting of dwarf palms is restricted to one type only, it will be found that the rate of growth, the period between planting and maturity, and the general fruiting characters of the plantation will be comparatively uniform where conditions are tolerably regular—whereas, with tall palms, growth and fruiting characters vary considerably so that tall plantations show much more irregularity as compared with fields planted with a single type of dwarf. In this connection it may be pointed out that the green race of dwarfs is hardier than either the red or the yellow race and produces a larger nut which gives a better copra and is, in fact, a good commercial proposition. The green dwarf palm is capable of producing, under good average conditions, not less than 20 lbs. of copra per annum with some 90 palms planted to the acre, whereas the average tall palm produces about 30 lbs. of copra per annum and an acre can carry only 50 to 55 palms, so that the proportionate yields per acre under good average conditions would be as 6:5 in favour of the green dwarf palm. That is, a plantation of green dwarf is capable of producing 20% more copra than the same area of "Talls" under fair conditions.

Should it be possible to obtain a pure Race of the tall coconut which would breed true to the character or characters for high yield, as the dwarfs appear to do, then the tall type would prove much superior, because many tall palms can produce annually an average of 85 nuts or more.

There is every hope of this possibility being achieved, but the results of observations on tall palms take so long to materialise, that the necessary proofs of the probability are not yet available.

In the meantime, a search is being made for some vegetative character or characters which can be correlated with high yield so that genetically high yielding palms may be recognised at an earlier date in their life period than is possible at present in order that selection may proceed at a much more rapid

pace. As is well known, the propagation of coconuts is only possible through the seed, there is no short cut like budding as in the case of rubber, so that the establishment of some growth character which can be correlated to yield at any early age in the life of the palm is of much importance.

Assuming the average palm to produce 60 nuts per annum (the actual average is lower) and that each nut produces 250 grammes of copra, then the average palm should yield approximately $(250 \times 60 \pm 450 =)$ 33 lbs. of copra annually.

Judging from the facts of variation which have been cited, it should be possible on new plantations to raise considerably the average yield per palm by the rigid selection of high yielding palms for the supply of seednuts for future plantings. Seven of the palms included in Table II show calculated yield values exceeding 50 lbs. of copra per annum while four of them even exceed 65 lbs. per annum and the 10 acre plot from which the data were collected carries many more such palms, so that the selection of palms as seed bearers is not a difficult matter. A plantation planted entirely with palms capable of producing 50 lbs. of copra per annum would be equivalent to an increased production per acre of approximately 50 % and even this increase might conceivably be exceeded.

While such an increase is possible, under practical conditions and considering the hybrid nature of many of the seed nuts, it is more likely that first generation increases would be of the order 25-35% but even this increase would be highly desirable.

Improvement of the coconut crop is a slow process, yet in view of the long economic life of the palm, selection, in existing plantations, of the best producing palms for seed purposes should prove profitable and attractive.

A REVIEW OF F.M.S. STATISTICS RELATING TO RUBBER PRODUCTION.

By

J. GORDON-CARRIE,

Deputy Supervisor of Rubber, F.M.S. and Deputy Registrar-General Statistics, S.S.

The year 1929 is the first for which almost complete statistics relating to rubber are available. Six years of Restriction of Exports of Rubber had, by the artificial conditions imposed upon the production of rubber, brought about many contradictory results. It had also, very unfortunately, given rise to certain misconceptions, not the least of which in importance was that regarding the productivity—and especially the relative productivity—of the big estates of 100 acres or more, and the smaller estates and holdings of less than 100 acres in area.

No doubt, to use the phrase coined by General Dawes, a major part of that misconception might be traced as due to the—quite futile—attempts to “apply a common yard stick” alike to the big estates and to the small holdings. Really they are not directly comparable.

During restriction, the maximum assessed allowance per acre given to any small holding was less than half that given to the highest assessed of the big estates. A similar, though not so great, difference in the average assessments per acre of large estates and smaller holdings existed in favour of the former.

It is, therefore, not difficult to understand why—after six years of that influence to distort their vision—prophets of the production to be expected during the first year of free production, seriously underestimated the potential production of Malaya's small holdings.

For the Federated Malay States, almost complete statistics relating to rubber have been made available by the Rubber Statistics Department. Tables of figures are, however, “dry bones” to most people. For that reason an attempt is made in this article, by the aid of graphs and charts which illustrate it, to present in a more attractive, and more easily understandable form some of the information which can be derived from the published statistics relating to rubber.

Chart A illustrates the areas planted with rubber in the Federated Malay States during the years 1923—1928. The chief point of interest is the great increase in the planting programme of big estates which was caused by the “boom” values of rubber during 1925 and 1926.

Charts B, C, and D are all illustrative of production figures: but in order to gain full information from them it is needful first to study somewhat carefully the following notes. With reference to Chart B it must be emphasised that while half of the columns thereon illustrate the actual monthly production of all estates of 100 acres or more, the adjacent columns show NOT the monthly

production of the smaller holdings but the amount sold to dealers monthly by the owners of such holdings.

In general, the owners of holdings less than 100 acres in area do not hold rubber off the market but sell as they produce. There are, however, times when for a few days the sales are retarded: and when such times occur at the end of a month the total sales in that month are lessened by an amount which, almost always, goes to swell the total sold in the next month.

For that reason the total production by holdings of less than 100 acres in any one month cannot be deduced directly from the statistics published monthly. These give, by the use of a simple calculation, the amount of the total sales during the month of rubber by such holdings.

If, however, the amounts sold monthly are averaged over three or four months, the figure so arrived at gives the average rate of production during that period. Thus, by the simple process of taking averages over periods of that duration, each such period progressing by one month, it is possible to arrive at estimates of monthly production which are almost exact. (The margin of error is within an extremely small percentage.)

Another factor of some importance is that crops harvested monthly by big estates—which are declared, and which Chart B illustrates—are, for statistical purposes, open to the objection that apart from seasonal variations they are also subject to the influence of their differing time components: e.g., April's crops are harvested in 30 days, as are June's, while the crops in the mid-month of May are garnered in 31 days.

It is, therefore, essential that any charts which can be regarded as correctly indicative of comparative yields shall illustrate monthly yields in terms of yield per day in each month. A further and useful development of that principle is to express such day-monthly yields in terms of equivalent yield per acre per annum.

Chart C illustrates the declared and calculated yields of large estates and smaller holdings expressed in terms of tons per day in each month. It is interesting to note from this Chart the gradual recovery from the effects of "wintering" and the fall in production in September and November which was due to interference with tapping by the unusually frequent rain, in tapping hours, experienced during those months.

Chart D illustrates the yields in terms of equivalent rate of production in pounds per acre per annum. It will be most interesting to see how the yield graphs for 1930 compare with these illustrated for 1929. Already the published statistics make it possible for proper estimates of production to take the place of the rough approximations of the past. In the not distant future the data then available should enable estimates to be made by elementary arithmetical methods; with results which will approximate to certitude of accuracy.

The productions illustrated in Charts C and D confirm the rate of production of big estates which a study of the Federated Malay States Booklet of Statistics Relating to Rubber must have indicated as probable. They will, how-

ever, astonish all save those few who realised that the small holders' potential production (at all events for any immediate present) was greatly underestimated during restriction.

It is fitting, and may be helpful, in concluding this article to add a few notes regarding production in 1930.

The graphs of Chart D show clearly that, during 1929, notwithstanding the phenomenal yields which certain large estates have harvested from some rested areas and by the new small-tasks-and-early-tapping system the *average* yield per acre of the large estates was considerably below the *average* yield of the smaller holdings.

It must, however, be remembered that though many of the Asiatic owned big estates tapped daily on half-cuts during 1929, alternate day tapping on half-cuts, or its equivalent, is the most heavy system of tapping which has been used on almost all European owned estates. (There were only five, partial, exceptions.) It has also to be remembered that very many European owned estates used, during the whole of 1929, variations of the A.B.C. and other systems which definitely kept out of tapping, in rotation, parts of their areas: while others only tapped alternate daily on one-third-cuts. *The General Average* of tapping on big estates during 1929 was, therefore, under-tapping rather than over-tapping: and production of big estates in general inflated only, so far as it was inflated, by the rested area factor.

The writer is of opinion that at the end of 1929 big estates, considered as one group, stood possessed of bark reserves in excess of those proven essential: and thus possessed of what amounts to a "hidden" potential added productivity if policy and/or the market called for additional production in 1930.

Should the tapping policy of 1929 be retained during 1930 there is a sufficient area of young rubber available for addition to the tapped area fully to offset any falling off in the yield of older areas. The writer, for reasons indicated, holds the considered opinion that the total production of big estates in 1930 will somewhat exceed their production in 1929.

The position of the smaller holdings is quite different. They, too, during 1929 reaped the benefit of restriction-imposed resting and/or light tapping: but during 1929, beyond doubt, and—to a lesser extent—during the period July—December 1928 the smaller holdings were over-tapped.

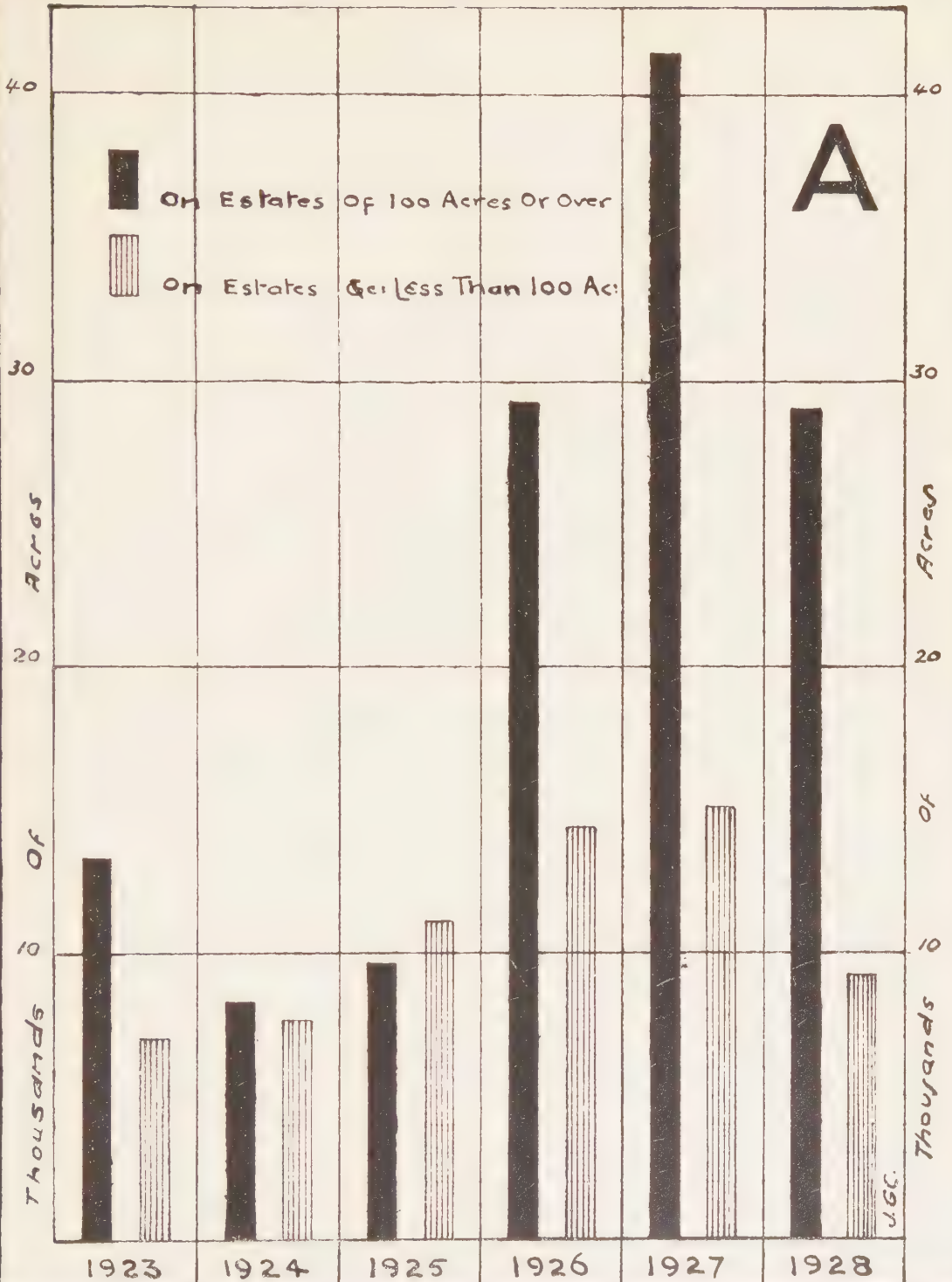
Though small holdings in general are not, as was stated at the beginning of this article, directly comparable with big estates (e.g. their stand of trees per acre is far higher, giving greater humidity, and they have not lost their top soil) it must be accepted as almost certain that after the "wintering" season in 1930—by which time, *inter alia*, the height of the average tapping out on small holdings will be considerably greater than it was during 1929—the average rate of yield per acre of small holdings will fall.

During 1930, the old rubber of the smaller holdings will continue to produce at a far higher rate than was generally thought possible, but, as stated in the preceeding paragraph, the rate of production is practically certain to fall appreciably.

ciably below that of 1929. Against that reduction is to be put the production of young areas first tapped in 1930: but the total decrease in the production of the old areas is almost sure to exceed any possible production of the newly tapped areas.

In short, the writer's conclusion regarding Federated Malay States production in 1930 is that, on balance, production in 1930 is likely to be almost the same as the production was in 1929: but that if market prices—or policy—called for it, the potential production of rubber in the Federated Malay States during 1930 could be increased, rather than diminished, as compared with the production during 1929.

AREAS PLANTED YEARLY 1923 - 1928



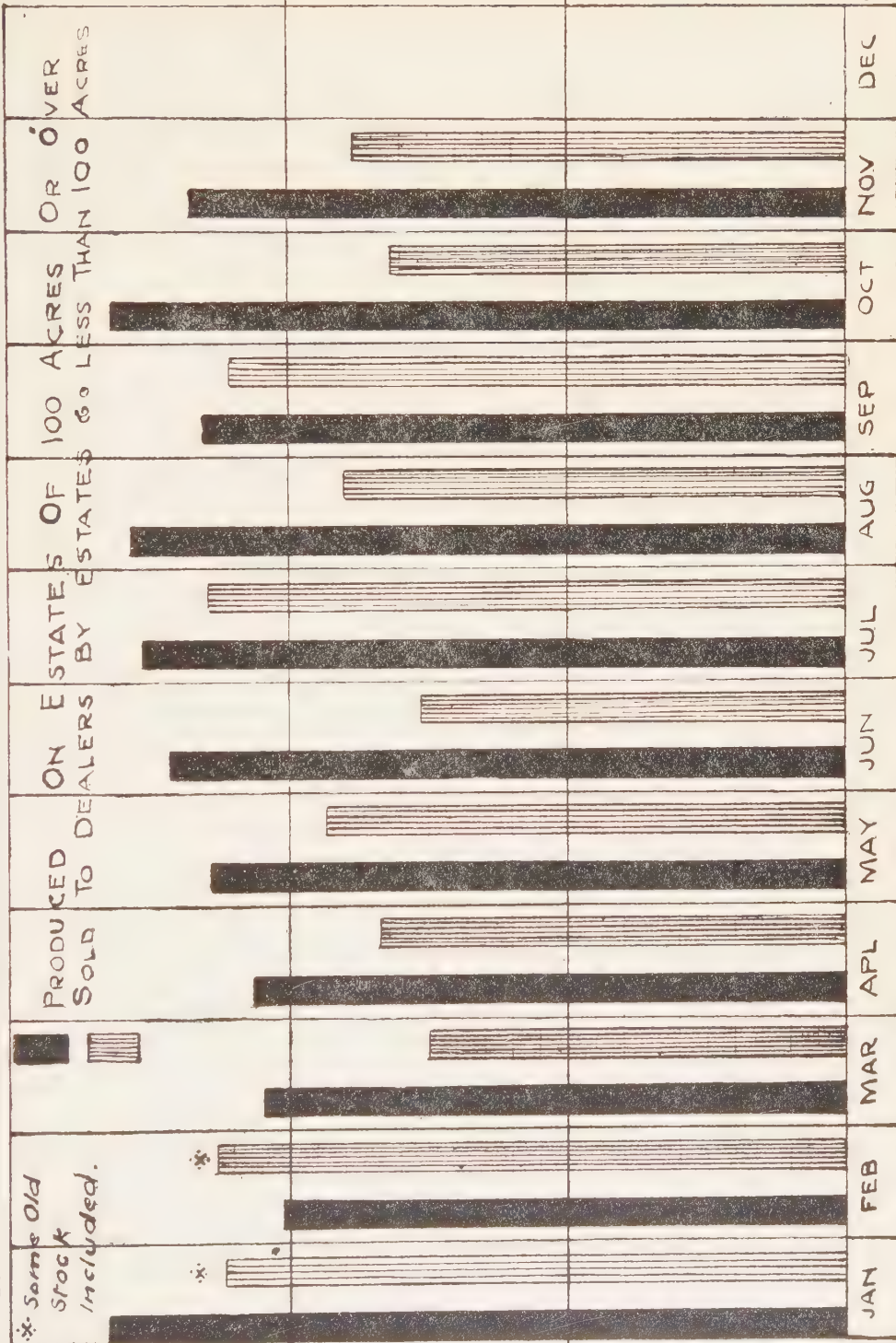
F. M. S. RUBBER STATISTICS

1929

B

Thousands
OF TONS

*: Some Old
Stock
Included.



Thousands
OF TONS

13 12 11 10 9 8 7 6 5 4 3 2 1

1929

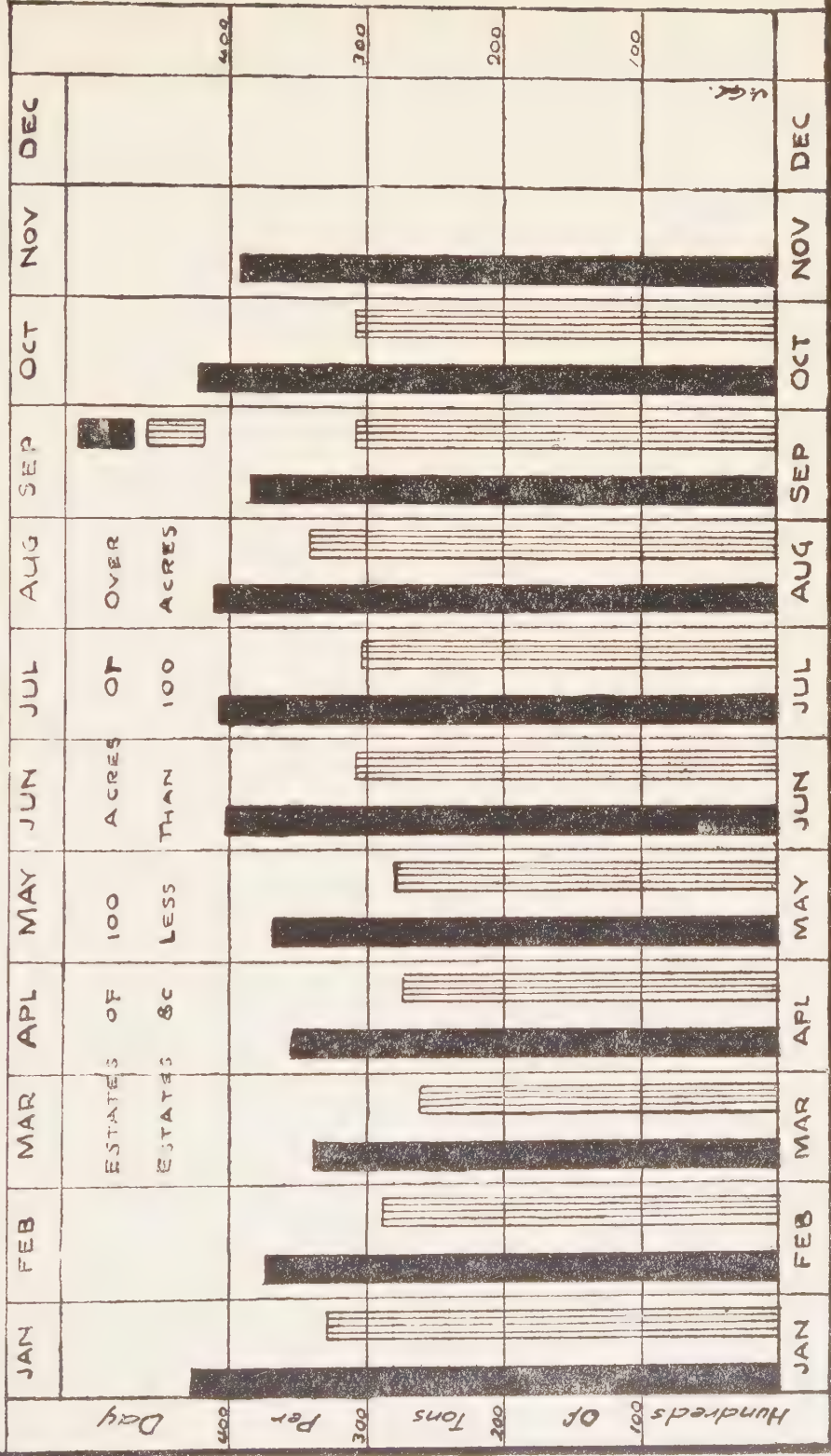
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

F.M.S. RATE OF PRODUCTION

(In Tons Per Day)

1929

C

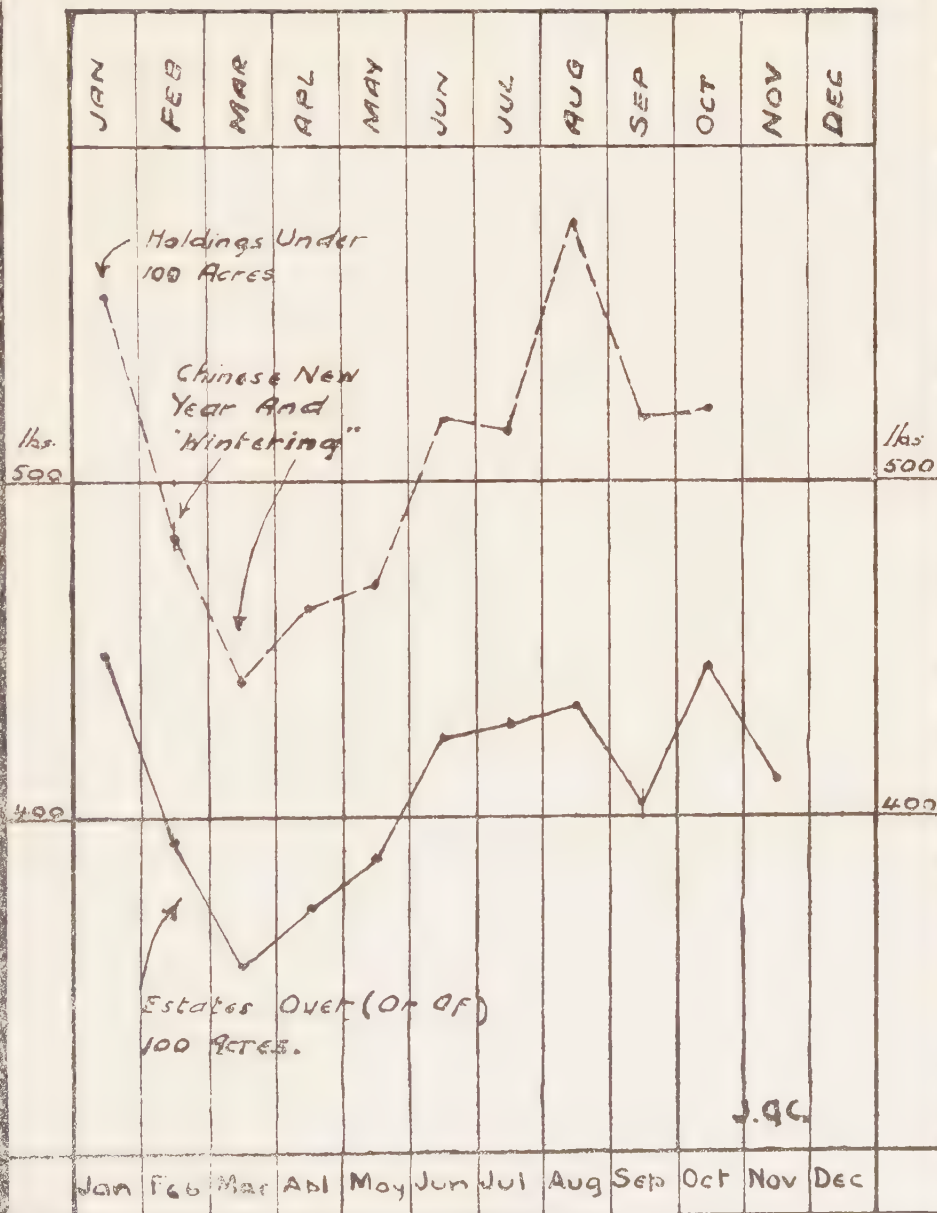


- F.M.S. PRODUCTION RATE -

Note.

This graph illustrates the yields
ON CHART C in terms of their
Equivalents in lbs. per acre yearly.

D



AGRICULTURAL RESEARCH.*

Information has come to hand with regard to a number of actions recently taken on the recommendations of the Imperial Agricultural Research Conference, 1927.

1. Chain of Research Stations.

The question of the establishment of a station in North Queensland is under the consideration of the Commonwealth Council for Scientific and Industrial Research. The Committee on the organisation of a Colonial Agricultural Service have recommended that until the staff of the East African Agricultural Research Station at Amani had been brought up to full strength, no further central research stations should be created, although the establishment of further stations will be considered in due course by the Colonial Advisory Council of Agriculture and Animal Health. The Empire Marketing Board has approved in principle of a capital grant of £10,000 and an annual maintenance grant of £11,000 for five years, to the Onderstepoort Station, South Africa, to function as a central research station in animal diseases.

2. Interchange of Information.

The question of the establishment of Imperial Agricultural Bureaux in Great Britain for the interchange of information among agricultural research and other workers in the Empire, was discussed at a Conference of Empire representatives which met in London in November, 1928. A scheme for the organisation of eight bureaux to be financed from a common fund made up by contributions from the Empire Governments and providing £20,000 a year for the next five years was worked out, and an independent "Executive Council" under the Chairmanship of Sir Robert Greig set up. The "Executive Council" decided to start the Bureaux for Animal Nutrition (Aberdeen) Animal Genetics (Edinburgh) and Fruit Production (East Malling) as from 1st April, 1929; those for Soils (Rothamsted) and Plant Genetics (herbage plants) Aberystwyth, from 1st May, 1929; those for Animal Health (Weybridge), Plant Genetics (Cambridge) and Agricultural Parasitology (St. Albans) in the Summer as contributions are assured. The Empire Marketing Board has undertaken the responsibility for the publication for a limited period, of an Empire Journal of Dairy Research. The first list of new and useful publications dealing with the preservation and transport of foodstuffs, will be issued shortly by the Department of Scientific and Industrial Research. A list of agricultural research workers has been supplied to all workers whose names appear in the list. With regard to conferences, the Pan-African Agricultural and Veterinary Conferences will be held in Pretoria

* Reprinted from "Tropical Agriculture." Vol. VI, No. 8.

in August, 1929, while the second West African Agricultural Conference is to be held in the Gold Coast in October, 1929.

3. Other Developments.

Amongst some of the other developments the following are mentioned: the establishment of a Colonial Advisory Council of Agriculture and Animal Health, a scheme for colonial veterinary scholarships, the consideration of practical steps that should be taken to secure the development of the teaching of biology by co-operation between Universities and Secondary Schools, and the question of developing the Edinburgh University Animal Research Department as a centre for animal genetics work. Soil and plant pathology problems have been brought to the notice of those concerned. A Virus Disease Committee has been formed. It is proposed to hold the Third Imperial Entomological Conference in London in June, 1930. A Committee of Chemists and Biologists has been formed by the Ministry of Agriculture to report as to the action required to carry into effect the recommendation of the Conference "that investigations should be made into the whole chemical field of insecticides and fungicides by chemists working in collaboration with entomologists and plant pathologists", while the question of the World Agricultural Census of 1930-1931 has been brought to the notice of the Governments of the Empire.

MANURIAL EXPERIMENTS WITH RICE.

In the August number of the Tropical Agriculturist,* the Economic Botanist (L. Lord) of the Department of Agriculture, Ceylon, gives the results of certain manurial experiments with rice carried out in two central padi stations in that Island to test the possibility of improving rice cultivation by the use of artificial and green-manures. The results of the experiments with green-manures are of particular interest to padi growers in Malaya. In 1926, at Anuradhapura, the results of ploughing in a crop of Sunn Hemp (*Crotolaria juncea*) grown *in situ* was investigated, and it was found that a 33% increase in yield was obtained. Owing to this promising result further experiments were laid down at Peradeniya in the *yala* season of 1928 and the *maha* season of 1928-29 with the object of finding out, not only the effect on yield of ploughing in green-manure, but also to determine the effect of ploughing in the green-manure at different times before sowing the seed.

Following the lines adopted in the 1926 experiment, the green-manure for the 1928 one was grown on the land, but owing to the uneven growth of the Sunn Hemp on different plots, it was realized that another experiment with similar quantities of green manure applied to each plot was desirable; therefore, in the 1928-29 test, each plot received the same amount of green material brought in from outside. As in the permanent manurial series 1/80 acre bunded plots were used (the inner 1/100 ac. being harvested separately) and each treatment was replicated four times in randomized blocks. Five tons per acre of wild sunflower (*Tithonia diversifolia*) were applied; one lot five weeks, and one lot one week, before the padi was transplanted. The results are given in the following table—

Treatment.	Calculated yield		Control = 100	Value of increase over control (@ Rs. 2-50 per bushel.
	per lb.	acre. bus.		
Control	2482	59	100.0	—
5 tons green-manure (early)	3318	69	116.7	Rs. 25-00
5 tons green-manure (late)	3847	80	135.3	Rs. 52-50

The increased yields of both treatments over the control are statistically significant as is also the difference between the early and late application.

* Manurial experiments with Rice. Part 1, by L. Lord, Economic Botanist. Tropical Agriculturist Vol. LXXIII, No. 2. August 1929

There can be no doubt that under the conditions prevailing at Peradeniya, the application of green material is extremely efficacious in increasing the yield of grain and late application is better than early.

If it can be shown, as the results of further experiments, that one ton of green material is as good, or nearly as good as five tons, there will be much more hope of extending the practice of green manuring in Ceylon.

The Agricultural Chemists (A.W.R. Joachim & S. Kandiah) co-operated in the experiments in order that the changes in the nitrogen content of the soil during the course of the experiments could be determined. The results of their investigations were published in the May issue of the above named Journal,* briefly they found that—

- (a) If green manures are incorporated in padi-soils at the time of puddling, i.e. late, large quantities of ammonia are made available at all stages of the decomposition process or of the crop growth; also the indirect effects of late green-manuring in increasing the surface film and hence the aeration of padi-soil and of the roots of the crop are appreciable.
- (b) By early green manuring, i.e. the ploughing in of green manures when the soil is semi-dry and allowing it to lie fallow, large quantities of nitrates are formed which are lost as free nitrogen, or leached out when the fields are flooded and puddled. If early ploughing has to be done, water should be let in immediately after to keep the soil quite moist. Ammonia production, which is beneficial to wet land padi, is thereby encouraged and is not lost on subsequent flooding.
- (c) From the above and other considerations it is obvious that from a chemical standpoint the burial of green-manures in padi-fields as late as possible before sowing or transplanting the crop is preferable to burying early.

It may be mentioned here that the practice of incorporating green material as late as possible before transplanting the young padi plants is one which is almost invariably followed by local Malays and shows once again how often old established agricultural operations are found to be scientifically sound.

* Laboratory and Field Studies on Green-manuring under Paddy-land (Anaerobic) conditions. Tropical Agriculturist Vol. LXXII, No. 5. May 1929.

WORLD TRADE IN SCRAP AND RECLAIMED RUBBER.

"The Rubber Age" for August 1929, contains several articles dealing with reclaimed and scrap rubber, perhaps the most interesting being on "World Trade in Scrap and Reclaimed Rubber" by Harry W. Newman of the Rubber Division, United States Department of Commerce.

The Author points out the great impetus to the industry resulting from the enforcement of the Stevenson Act 1925, which by sustaining prices at a high level, forced manufacturers to seek some element which would relieve the high cost of production, and turned them naturally to the use of reclaimed rubber. While for various reasons it is impossible to obtain reliable statistics of the consumption of reclaimed rubber, it is estimated that more than 40,000,000 lbs. (17,857 tons) of reclaimed rubber were exported in 1928. The trade in scrap, waste and old rubber used for reclaiming in the United States, Great Britain, Germany, Netherlands and Canada shews an increase of 183 per cent. between the years 1924 and 1928, which indicates the trend of the reclaimed rubber industry.

Despite the heavy decline in the price of crude rubber during 1928 upon the announcement and subsequent repeal of the Stevenson Restriction Plan, the demand for reclaimed rubber was fully maintained—in fact, it increased. During the period of high prices, manufacturers were induced to experiment with the reclaimed material and perfected it to such a degree that its use is not likely to be abandoned readily. Furthermore, manufacturers discovered that its use is not only economical in the fabrication of many rubber articles, but practical and best suited for their peculiar needs.

The reclaimers, however, have always in mind the possibility that a continuance of low-priced crude rubber may create a tendency to reduce the use of the reclaimed product and are considering the best means to develop its consumption. French reclaimers have already taken the initiative and recently held a meeting for their interests.

The United States, according to the official census of 1927, produced 330,435,663 pounds of reclaimed rubber for sale, and exported 19,130,429 pounds. The former figures, however, do not include the many thousands of pounds of rubber which were reclaimed at the factories of the large manufacturers for their own use, and for which no figures are available. Consequently, the total production of reclaimed rubber in the United States is far in excess of the amount which is sold on the open market.

The United States is maintaining its lead in the exports of the reclaimed product, the figures for the first half year of 1929 showing an amount in excess of 70 per cent of the total exported for the previous year. Canada in 1928 took 82 per cent. of the United States total exports of reclaimed rubber, and Great Britain—the only other important outlet—took 12 per cent. of the total.

The United States draws the bulk of its export trade in scrap and old rubber from the 73,890,000 automobile tires which are annually discarded.

Exports of Reclaimed Rubber.

The following table shows the trend of exports of reclaimed rubber during the past five years from the countries which separately enumerate reclaimed rubber in their trade statistics.

Exports of Reclaimed Rubber
(Pounds).

Country.	1924	1925	1926	1927	1928
United States	5,458,157	10,239,876	12,075,640	19,130,429	21,452,956
United Kingdom	816,400	3,574,900	4,582,500	5,690,900	8,064,625
Italy	180,948	323,768	236,710	1,098,694	297,540
Netherlands	3,218	15,686	6,065	130	2,204
Sweden	11,392	604	4,259	17,632	31,411
Poland				3,306	

The reclaiming industry in France is of importance. Inasmuch as the domestic supply of scrap rubber is inadequate for the national requirements, large quantities are imported—principally from the United States. Great Britain is the second foreign source of supply, and Germany probably occupies third place. The recent failure of a large German reclamation plant has directed extra quantities of old rubber from Germany into France.

Owing to the increased production in the past three years, the supply of reclaimed rubber from domestic sources is more than adequate for the French demand and augmented quantities are exported. From estimates made by leading producers, the annual production approximates 9,000 metric tons, or about 30 tons per working day. In addition, large manufacturers such as Michelin, Hutchinson, Dunlop and others have their own plants for reclamation operations, the production totals of which are not available.

The Caustic Soda process is used practically by all rubber reclamation units in France. Economy in production is favoured by low wages.

The writer gives details of the reclaimed rubber trade on the Continent, shewing that these countries have found it necessary to import considerable quantities of scrap and reclaimed rubber for manufacturing purposes.

The larger British reclaimers of rubber scrap are located in the north of England, particularly around Manchester, where they consume not only the large surplus of old rubber articles discarded in the Kingdom, but import large quantities from the United States and the Continent. The latest available figures indicate that the United States supplies about 60 per cent. of the British imports of waste and reclaimed rubber, and of the total British imports about 40 per cent. is shipped to Manchester.

Reclaimed rubber has also found considerable markets in other countries, notably in Japan, Australia and Italy.

BOOK REVIEWS.

“Technical Reports and Reports of Divisional Agricultural Officers’ of the Ceylon Department of Agriculture for 1928”

The Reports of the Technical Divisions and of the Divisional Agricultural Officers of the Ceylon Department of Agriculture for the year 1928 have recently come to hand. A departure has been made from the usual procedure inasmuch as the whole of the Technical Reports are bound in one volume and the Reports of the Divisional Officers in another, instead of as previously, being issued as a series of separate bulletins; this has the advantage of greater convenience and moreover serves to emphasise the distinction between the two branches viz. Research and Extensional into which the work of Agricultural Departments naturally tends to divide itself. Technical Reports comprise those of the Mycologist, Entomologist, Chemist, Economic Botanist and Agriculturist in Charge of the Central Experimental Station. In the Entomological Section considerable space is devoted to a review of the work on Termites to which the Division has given much attention during the year, the work subdividing itself into two sections, viz. work on the various species of caloterms which attack living plants, and those Termites which attack buildings. A useful adjunct to the Mycological and Entomological Sections of the Report is the appending thereto of the Reports of the divisional plant inspectors which facilitates the whole of the pest and disease work being viewed in complete perspective.

A considerable part of the work of the chemical division was concerned with soils, and in particular with attempts to estimate by the examination of soil suspensions, the amount of colloidal matter carried away from the soil erosion plots at the experiment station.

The report of the Economic Botanist is mainly concerned with padi work which has now been established on a considerable scale; the work in Ceylon is still confined to pure line selection in which direction it is held that the possibilities are still so large that no serious attempt at producing superior strains by hybridization have yet been made. Four rice breeding stations have now been established while the strains evolved are tried out at twenty-three test stations supervised by the Divisional Agricultural Officers. During the year 330 new selections were made and nearly 500 were in addition discarded.

The reports of the Divisional Agricultural Officers comprise an account of the various extensional activities undertaken. The Island is at present divided into four agricultural districts viz. Central, Southern, Northern and North-Western each of which is in charge of a trained divisional officer with subordinate staff.

In each division there exists a series of experiment demonstration and test stations which serve as centres for trials of new and improved crops and varieties

of crops and agricultural methods as well as for the distribution of planting material.

In two divisions viz. The Central and the Northern, Agricultural Schools are maintained, to give training to the sons of native agriculturists, while there are also special classes for headmen and village school teachers. Each divisional officer has charge of the school garden work in his division, in all there are in Ceylon 663 school gardens as against 437 in the F.M.S. and S.S., the standard of work in this direction is high in Ceylon, progress being stimulated by competitions for which prizes are provided. Agricultural competitions were held in all districts with the object of stimulating the improvement of the standard of cultivation by small holders, competitions being either on the basis of a particular crop or else on a general basis. Government financed produce purchase schemes were operated in respect of tobacco in the Northern Division and cotton in the Hambantota district of the Southern Division; these schemes have for their object the stimulation for native industries by the provision of marketing facilities on a fair basis. The schemes appear to be having favourable effect inasmuch as areas cultivated are steadily increasing. Other activities have comprised meetings and demonstrations, while the supervision of co-operative Credit Societies is also vested in the divisional officers. The report as a whole comprises a record of a large amount of useful work on soundly conceived lines.

H.A.T.

"The Tropical Crops."

A POPULAR TREATMENT OF THE PRACTICE OF AGRICULTURE IN TROPICAL REGIONS WITH DISCUSSION OF CROPPING SYSTEMS AND METHODS OF GROWING THE LEADING PRODUCTS.

By OTIS WARREN BARRETT.
(*New York: The Macmillan Co. 1928.*)

The subject of tropical agriculture is one of such magnitude that any attempt to deal with it in the space of 445 pages must of necessity become little more than a summary of crops and crop systems. In the particular case the author, who is Director of Agriculture and Labour, Porto Rico, has endeavoured to present the data regarding the world's principal tropical crops in the light of first hand observations based on thirty years of practical experience.

The greater part of the book is confined to the major permanent and semi-permanent tropical crops, more particularly to those of the Caribbean—American zone with which the writer is evidently most familiar. Such crops as Coffee, Cocoa, Coconuts, Citrus, Bananas and Sugar Cane are each dealt with at some length as are also Rubber and Pineapples, two crops of interest to readers in this country.

On the other hand, in so far as the main arable and dry zone crops of the Tropics are concerned, the subject matter is decidedly curtailed. Rice, which the author acknowledges to be the world's most important crop is dismissed in the space of three pages. Other grain and forage crops, oil seeds, fibres of the importance of Sisal and Jute, together with Tea are similarly but briefly dealt with. Furthermore, such crops as Cotton and Tobacco, though extensively grown in the sub-tropics, are nevertheless of considerable importance and interest in tropical agriculture and deserving of more attention than has been given them in the text.

The Chapter devoted to tropical field practices and conditions is of interest having regard to the profound importance of many of the principles laid down. Here again, however, information is so curtailed as to render it of little practical value.

Presenting as it does a summarised review of the world tropical crops and crop systems together with an impression of the ever-increasing importance of the products of tropical agriculture in the economic life of the temperate regions, the book is of interest. Its main value, however, lies in the subject matter dealing with those crops with which the author is definitely familiar and which he has been enabled to treat in the light of long practical experience of their culture and economic aspect.

R.G.H.

MALAYAN EXHIBITION, 1930.

The Seventh Annual Malayan Exhibition, organised by the Malayan Agri-Horticultural Association, will be held during the Easter Holidays, 19th to 21st April, 1930, on the Association's ground at the junction of Ampang Road and Circular Road, Kuala Lumpur. The usual sections for Agriculture, Horticulture, Rubber, Poultry and Village Industries will be included, preliminary schedules for which have been prepared and may be obtained on application to The Secretary, M.A.H.A., P.O. Box 323, Kuala Lumpur, to whom all communications in connection with the Exhibition should be sent. It is anticipated that the Department of Agriculture, the Rubber Research Institute and the Committee for Public Health Education will co-operate by staging departmental exhibits.

FROM THE DISTRICTS.

The Weather.

Unusually dry weather for December prevailed generally although fairly frequent and sometimes heavy afternoon showers fell in parts of South Perak, Selangor and Negri Sembilan. The contrast to the usual December conditions was particularly striking in Pahang where the rivers showed no signs of flooding whilst in the Pekan district the rainfall was only about 5 inches as compared with an average precipitation for December of over 28 inches.

Remarks on Crops.

Rubber.—Brief notes are to hand from South Perak regarding a replanting programme to replace 27 year old trees. Replanting with budded stumps is being done immediately after clearing off the old trees and the programme provides for planting a definite area each year. Prices paid for small holders rubber ranges from \$26/- a pikul for unsmoked to \$28/- to \$30/- a pikul for smoked sheet. It is reported from West Pahang that this low price is reflected in the lower standard of general maintenance in the holdings and increased difficulty experienced in obtaining efficient control of disease, especially that of Mouldy Rot which entails cessation of tapping for a period. This experience is likely to become general if the price remains for a prolonged period at its present level. The incidence of Mouldy Rot (which in small holdings, is the disease of main importance at the moment) is directly connected with weather conditions. Thus, from Selangor and the Perak South areas bordering thereon and from Negri Sembilan, the disease is reported to be much in evidence, whereas elsewhere it has shown less virulence, although in parts of West Pahang the difficulties mentioned in obtaining efficient control have resulted in a slight increase in the number of cases reported.

Padi.—In the north of the Peninsula, crop prospects as regards late planted areas are very uncertain, as the dry weather of December has had a bad effect on padi that is in the stage when it should be making rapid growth. In these areas the unseasonable weather has favoured the increase of certain pests, notably a leaf-hopper (*Sogatia pallescens*) which of late years has been responsible at this time of year for considerable damage to the padi crop at such times as general conditions have been conducive to the insects' rapid reproduction. Unfortunately these unfavourable conditions for the crop prevail over a large portion of the important padi areas of Krian and Province Wellesley. Suitable weather may yet result in a fair harvest, but is unlikely, as weather that would be suitable for the crop will not be such as is normally experienced during the next three or four months. In areas where early planting was rendered possi-

ble by earlier rains or a sufficiency of irrigation water, crop prospects are good. This applies to Upper Perak and a large part of the district of Kuala Kangsar.

Crop prospects are reported to be promising in South Perak and in the inland districts of Selangor. In Negri Sembilan a good crop is expected except in the mukims of Pantai and Lenggeng, whilst in Malacca prospects as to yield are bright, especially in Alor Gajah district.

In West Pahang a fair crop was reaped in mid-December in Lipis and Temerloh districts and is now being reaped in Bentong district. In Raub district the age of the padi was extremely variable. A fair crop was being reaped in Dong mukim whereas in other mukims plants were in the growing stage and in one mukim transplanting in progress. In East Pahang the harvest which is completed, was variable but on the whole somewhat poor, plants having suffered from drought during the growing period.

Organised rat control with the help of a special staff is established in the padi areas of Krian, Province Wellesley and Malacca. Rewards were paid during the month for 29,250 rats killed in Krian, 34,350 in Province Wellesley and 1,919 in Malacca. The organisation has been inaugurated only recently in Malacca and cultivators are as yet reluctant to bring in tails to claim the reward. The same difficulty was experienced in Krian and Province Wellesley when a Rat Campaign was first organised in those areas. In parts where no special organisation exists, distributions of traps and poison have been made, the success varying in proportion as to whether the majority or only a few cultivators make practical use of the advice given them. Experience in Krian over a number of years indicate that rats can be effectively controlled in padi areas if trapping and poisoning is continuously carried out with vigour over the whole area concerned.

Tea.—A fresh application for a grant of a little over 100 acres for this crop was made in South Perak.

Bananas.—Decreased productivity of this crop on an area of approximately 3,500 acres in Negri Sembilan was brought to the notice of this Department. Undoubtedly, the reasons for declining yields are decreased soil fertility and Panama Disease, the effects of the latter possibly being inversely proportional to the degree of soil fertility. The maintenance of the soil in a reasonable state of fertility for this gross feeding crop in a country where farm-yard manure is a scarce commodity is a problem not easily solved. Recent investigations indicate that Banana production in Malaya is insufficient to meet the demand and it would appear to be desirable to increase the area of this crop, more especially in localities situated within convenient reach of the large towns.

Notes on Demonstration Stations and Padi Test Plots.

Kuala Kangsar.—Approved varieties of Bananas were planted and a model school garden laid down during the month. Experiments with Poultry were

commenced with imported birds consisting of White Wyandottes, Rhode Island Reds and Light Sussex fowls and Aylesbury and Khaki Campbell ducks.

Seremban.—Plantings of further fruit trees, Coffee, Maize and various varieties of Sweet Potato were made and Soya Beans and fruit seedlings were distributed.

In West Pahang, measurements of standard trial plots were made at the Dong and Temerloh Padi Test Stations whilst the Bananas and Food Crops made good growth at Kuala Lipis Demonstration Station. At Pekan, the wet padi on the Test Plot was harvested and a plant house was in course of erection at the Demonstration Station. The dry padi areas proved a complete failure owing to drought.

Malacca.—The Padi Station at Pulau Gadong looked very promising at the end of the month when it was visited by the Director. From the Fruit Station on Pringgit Hill distributions were made for the establishment of a School Fruit Garden.

School Gardens.

In Province Wellesley and Penang, all school gardens were reported upon in connection with the annual prize competition. Reports from elsewhere indicate general progress towards assumption by the Field Officers of fuller responsibility for the condition of School Gardens.

Other Items of Interest.

The dredged and slimed plot at Kamunting in North Perak on which green dressings have been established with the object of rendering the land capable of producing good padi crops has been bunded and a waterway made with a view to planting the first padi crop thereon next season.

The Perak Water Hyacinth gang was engaged on clearing the Samagaga river and other waterways in the vicinity of Krian irrigation area, whilst the Province Wellesley gang was employed in clearing the weed from minor streams and drains. Isolated patches were dealt with elsewhere.

It is reported from Negri Sembilan that the price of locally grown Chillies has become considerably enhanced of late. At present prices the cultivation of this crop offers good profits to enterprising small cultivators.

In Malacca, the Field Officer attended a demonstration given at Mr. Van Cant's plant for the extraction of Rubber Seed Oil by chemical process.

DEPARTMENTAL NOTES.

Field Officers' Conference 1929.

An interesting new departure in departmental policy which has recently taken place consists in arrangements for the holding of Annual Conferences of Field Officers. The object of such conferences is to make provision for the regular interchange of views on matters in the Field branch of the Department, to provide facilities for comparing results and methods of work in different districts, to permit of personal contact being established with the Research Officers of the Department and to allow exchange of views between the Field Officers and the Head Quarters Staff.

The work of the Field branch of the Department consists essentially of what is termed extensional work combined with the control of pests and diseases. Hitherto extensional work performed by the Department has been restricted in character, and its scope is far less extensive than similar work in the neighbouring colony of Ceylon and in the Dutch East Indies. For some time past plans have been under discussion for extending and amplifying the work in progress with a view to bringing it more in line with modern ideas, and in this connection a scheme for extension of activities has recently been drawn up; one of the main objects of the conference was to enable these proposals to be discussed with the Field Officers of the Department as a whole so as to ensure so far as possible that the programme was co-ordinated with the needs of the country.

The main points of the proposals consist in the establishment of a considerable number of Demonstration Plots and Test Stations throughout the Peninsula together with facilities for distributing planting materials. At present such facilities are largely non-existent. At the same time re-organisation of the Asiatic staff in the Field side was discussed and details in relation thereto worked out with a view to submission of a definite scheme to the Government. Other matters considered comprise questions in relation to the establishment of School Gardens, co-operation with the Rubber Research Institute and with the Co-operative Department, in propaganda and extensional work, the organisation of agricultural shows, and the possibilities of film propaganda. On the second day of the conference Officers of the Co-operative Department and the Rubber Research Institute attended the meeting, by invitation, and took part in the discussion of proposals for co-operation with their respective organisations.

During the conference members visited Serdang Experimental Plantation, the Rubber Research Institute and the Experimental Station of the Rubber Research Institute at Sungei Buloh, while the Director of the Co-operative Department made arrangements for delegates of the Conference to see the departmental film on co-operation.

It is proposed to hold these conferences annually in future; the results of the 1929 conference are distinctly encouraging and there would appear every reason to hope that this step will prove of value in bringing about an increase in the efficiency and the utility of the Field side of the department.

Appointments.

Mr. F. C. Cooke, A.R.C.S., B.Sc., A.M.I. Chem. E., appointed Assistant Chemist for Copra Investigation on 22nd August, 1929, and arrived on 19th September, 1929.

Mr. R. G. H. Wilshaw, B.A., B.Sc., A.I.C.T.A. appointed Assistant Agricultural Chemist on 19th September, 1929, and arrived on 17th October, 1929.

Leave.

Major C. D. V. Georgi, O.B.E., Acting Agricultural Chemist, has been granted eight months and thirteen days leave on full pay, with effect from 15th November, 1929, inclusive.

Mr. W.N.C. Belgrave, Plant Physiologist, returned from leave of absence on 29th November, 1929.

Mr. D. H. Grist, Agricultural Economist, returned from leave of absence on 29th November, 1929.

Mr. A. E. Coleman-Doscas, Agricultural Field Officer returned from leave of absence on 18th December, 1929.

MARKET PRICES.

December 1929.

Rubber.—The average London price for December 1929 was 7.9 pence per lb., the highest price quoted being 8 1/16d., the lowest 7 13/16d. The average price in Singapore was 26½ cents; the lowest being 25½ cents, and the highest 27¼ cents.

Copra.—On November 27, Straits F.M.S. Copra was quoted in London at £23.7.6 per ton C.I.F., compared with Ceylon F.M.S. at £24.7.6.

Singapore prices varied from \$9.55/9.35 S.D. and \$9.05/8.85 F.M. per picul.

Palm Products.—Kernel was dull and unchanged at the beginning of the month: deodorised 41s., crude 35.6d. spot. Palm oil shewed some recovery, the market being fairly steady, but business only moderate: Lagos 34s; softs 31.6d; mediums 31.9d; hards 34s; bleached 34s.

Coffee.—"The British Trade Journal" for December states:—

"The glut in coffee, and the difficulties of the Brazilian Coffee Defence Committee continue to hamper the market. The fall in prices continued during November, Jamaica dropping from 220s. to 210s. per cwt., Costa Rica med. from 155s. to 150s., Kenya, good med. to 105s., and Brazils (Santos) to 90s. East African supplies increased considerably in 1929 and met with excellent demand. The only remedy for the Brazilian position is to reduce production or discover new markets and stimulate the demand by well considered propaganda."

Tapioca.—Med. Pearl 23s. to 24.6d. per cwt. E.I. Flake, fair, spot 21.6d. per cwt.

Singapore reports on 21st December; Flake, small fair, \$5½ per picul; Pearl \$8 per picul.

Sago.—Pearl, Fair \$8¼, Flour No. 1 Borneo, Sarawak, Singapore \$4.45/4.57½ per picul.

Pineapples.—The price for 100 fruits ruling in Singapore ranged from \$1.50 to \$1.80 for average, \$2.50 for best quality and eighty cents for unripe fruits. The price for No. 1 quality tinned Singapore Pines was \$3.75 a case of 48 tins of 1½ lb. cubes.

Spices.—Cloves, Penang 1s. 8d. to 1.10d.

Zanzibar 1s. 1¼d.

Mace ord. to gd., per lb. 3.3d. to 3.10d. Pepper, black. Singapore prices \$46/45 per picul on December 14, falling to \$44¼/43½ on December 21st.

Nutmegs. 110 per lb. \$34 Singapore on December 21st.

80 per lb. \$37 Singapore on December 21st.

Essential Oils.—Citronella oil—Java 3.4d. per lb. c.i.f. U.K. port. The market has continued to rule strong.

Lemongrass oil—4s. per lb.

Olive Oil (90/92%)—8s. per lb.

Patchouli oil—Singapore spot cheaper from 20s. to 21s. per lb.

Gambier.—No. 1 and No. 2 cube, \$14 $\frac{3}{8}$ per picul at Singapore.

The above price list is intended to indicate the trend of prices during the latter half of November and the first half of December. With the exception of rubber for which the daily quotations for December have been examined, the information given has been drawn from The Singapore Chamber of Commerce Market Reports; "The British Trade Journal and Export World" for December; "Tropical Life", December; "The Chemist and Druggist", December 7th; "The Chemical Age", November 30th; and "The Perfumery and Essential Oil Record" November 19th.

Prices stated in sterling are London quotations, while those in Straits dollars (\$1=2s.4d.) are Singapore quotations.

It is hoped that present efforts will be successful in arranging for a special monthly market report from London so that readers may be in possession of the latest market movements.
